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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1985.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

2. WATER CYCLE

2A. General

INTERFLOW MODEL: I. MODEL DEVELOPMENT,
Alberta Univ., Edmonton. Dept. of Soil Science.
D. S. Chanasyk, and J. P. Verschuren.
Canadian Water Resources Journal, Vol. 8, No. 1, p 106-119, 1983. 4 Fig, 16 Ref.

Descriptors: *Interflow, *Hydrologic models, Forest watersheds, Soil properties, Land use, Mountainous watersheds.

Field studies in forest hydrology, conducted over the past 15 years, have shown that interflow is the major flow process on forested, mountainous watersheds. Existing hydrologic models cannot be rigorously applied to these watersheds because of the empirical treatment of interflow in these models. A hydrologic model called the SLUICES (Soils and Land Use affecting Interflow and Creating Effects on Streamflow) model, was developed to overcome these limitations. The model emphasizes the dominance of interflow, is distributed in nature and yet is simple in structure, containing only seven easily obtainable or optimized parameters. A study was conducted to evaluate the sensitivity of model parameters. (Author's abstract)
W85-04577

INTERFLOW MODEL: II. MODEL VALIDATION,
Alberta Univ., Edmonton. Dept. of Soil Science.
D. S. Chanasyk, and J. P. Verschuren.
Canadian Water Resources Journal, Vol. 8, No. 2, p 1-18, 1983. 6 Fig, 7 Ref.

Descriptors: *Interflow, *Model studies, Forest watersheds, *Jamieson Creek watershed, *British Columbia, Mountainous watersheds, Simulation, Hydrographs, Storms.

The SLUICES model was developed for the purpose of simulating interflow on forested, mountainous watersheds on a distributed basis using a grid system. The Jamieson Creek watershed located in the Seymour River Basin near Vancouver, British Columbia was selected for model validation since interflow plays a dominant role in determining discharge from that watershed. Simulated hydrographs were compared to recorded ones for seven storms, using one storm to optimize parameters. The relationship between grid size and time interval was examined and a relatively simple technique for initializing moisture conditions was derived. Simulations for the storms provided good results, as did those for extended time periods. As a result, the SLUICES model shows promise as an interflow model and its distributed nature gives it flexibility. (Author's abstract)
W85-04579

HYDROLOGY AND SEDIMENTOLOGY WATERSHED MODEL. PART I: OPERATIONAL FORMAT AND HYDROLOGIC COMPONENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, B. J. Barfield, A. D. Ward, and I. D. Moore.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1370-1377, September-October, 1984. 9 Fig, 4 Tab, 22 Ref. EPA grant KY01212.

Descriptors: *Model studies, *Watersheds, *Hydrologic models, *Sedimentology, Sedimentation basins, Grass filters, Grasses, Check dams, Routing, *Rainfall-runoff relationships.

The operational format and the hydrologic component of a design oriented simulation model called SEDIMOT II is described. SEDIMOT II is capable of evaluating the hydraulic and sediment response of a watershed as well as the sedimentation effectiveness of detention ponds, grass filters, and check dams. The user of this model divides the drainage basin into subwatersheds of relatively uniform land use. A hydrograph, sedimentgraph, and particle size distribution are determined for each subwatershed, routed downstream and then combined to form a composite hydrograph, sedimentgraph and size distribution. In the hydrologic component of SEDIMOT II, the SCS's curve number method is used to determine rainfall excess, unit hydrograph theory is used to calculate a runoff hydrograph, and Muskingum procedure is used for channel routing. The accuracy of the hydrologic component was evaluated for twenty-seven storms. For all storms the SCS's curve number was known a priori. Excellent to fair agreement was obtained between predicted and observed hydrographs. A sensitivity analysis of hydrologic parameters was also conducted. (Collier-IVI)
W85-04735

HYDROLOGY AND SEDIMENTOLOGY WATERSHED MODEL. PART II: SEDIMENTOLOGY COMPONENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, B. J. Barfield, I. D. Moore, and R. C. Warner.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1378-1384, September-October, 1984. 5 Fig, 2 Tab, 29 Ref. EPA grant KY01212.

Descriptors: *Model studies, *Watersheds, *Hydrologic models, *Sedimentology, *Sediment control, *Soil loss, Sedimentation basins, Grass filters, Grasses, Check dams, Particle size.

A hydrology and semdimentology simulation model called SEDIMOT II was developed which has the capability of evaluating alternatives in sediment control technology. Emphasis on predicted results is placed on the relative differences between different options rather than on absolute quantities. In SEDIMOT II, the sediment yield is calculated using either a subroutine called MUSLE (Modified Universal Soil Loss Equation) or a detachment-transport algorithm called SLOSS. Sediment yield is partitioned by assuming that the load rate is a power function of the flow rate. The particle size distribution of eroded sediment is adjusted for selective deposition by assuming that the largest particles are trapped first. The sedimentation effectiveness of three different types of sediment control structures can be evaluated in SEDIMOT II; to do so requires calculation of the sedimentgraph and particle size distributions associated with the sediment yield. In SEDIMOT II the sedimentgraph is determined by assuming that the load rate is proportional to the flow rate. The particle size distribution of eroded sediment is entered by the user and then adjusted for selective deposition. Sedimentation effectiveness of detention ponds, grass filters, and porous check dams can be evaluated. (Collier-IVI)
W85-04736

APPLICATION OF TRACER TECHNIQUES FOR DETERMINING THE WATER BALANCE IN SMALL CATCHMENT BASINS; A RESEARCH CONCEPT FOR THE EXPERIMENTAL BASINS IN THE UPPER HARZ MOUNTAINS (ANWENDUNG VON TRACERTECHNIKEN ZUR ERFASSUNG DES WASSERUMSATZES IN KLEINEN EINZUGSGEBIETEN; EIN FORSCHUNGSKONZEPT FUR DIE OBERHARZER UNTERSUCHUNGSGEBIETE),
Technische Univ., Brunswick (Germany, F.R.). Inst. fuer Geographie.
A. Herrmann, P. Maloszewski, R. Rau, W. Rosenow, and W. Stichler.
Deutsche Gewasserkundliche Mitteilungen, Vol 28, No. 3, p 65-74, July, 1984. 11 Fig, 2 Tab, 48 Ref.

Descriptors: *Tracers, *Hydrologic budget, *Harz Mountains, *Germany (Federal Republic), Isotopic tracers, Environmental tracers, Dye releases, Groundwater, Precipitation, Runoff, Snow cover, Model studies, Hydrologic models, Groundwater movement.

Tracer techniques currently in use in small catchment basins in the Upper Harz Mountains (Federal Republic of Germany) for the determination of water balance are described, based on a literature review. The Harz project employs a combination of the three most common tracer groups: fluorescent dyes; naturally present ions, compounds and electrical conductivity; and environmental isotopes. Basic long-term hydrological information on precipitation, runoff, snow cover, and groundwater is obtained through environmental isotopes and is supplemented by hydrochemical procedures and special dye-tracer experiments in groundwater. To answer process-related questions of water balance, separate models of the relevant hydrological substorage systems are constructed. Hydrological models transform given tracer input function into system-specific output functions; such a model is used to separate direct runoff components from indirect. Other models include mathematical flow models to interpret experimental environmental-isotope data for pore-water and fissure-water systems. In order to develop a model for the entire catchment basin, these models plus a comparison with results of purely hydrological studies should be used. (Moore-IVI)
W85-04804

2B. Precipitation

METHOD FOR ESTIMATING PRECIPITATION AMOUNTS AT REMOTE FIELD SITES,
Bureau of Land Management, Vale, OR.
R. R. Kindschy.
Northwest Science, Vol. 58, No. 4, November, p 256-261, 1984. 3 Fig, 2 Tab, 6 Ref.

Descriptors: *Precipitation, *Estimation, Malheur County, Oregon, Rangeland, Linear regression analysis, Crop year.

Production of vegetation on comparable sites within the semiarid rangelands of the intermountain western US is more influenced by precipitation occurring during the crop year (September through June inclusive) than by any other variable. The sparse distribution of weather stations typical of the intermountain rangeland area does not allow site specific analysis of localized precipitation. Crop year precipitation data for seven permanent recording stations in Malheur County, Oregon were analyzed for the 13 year period 1966-78. Elevation above sea level for each station was compared to precipitation received during the crop year through linear regression analysis. Analysis of precipitation amounts occurring on the arid sagebrush steppe revealed significant correlation with elevation. The method can be used to yield precipitation data for use in the determination of vegetation production. (Baker-IVI)
W85-04667

STATISTICAL INFERENCE FOR POINT PROCESS MODELS OF RAINFALL,
Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith, and A. F. Karr.
Water Resources Research, Vol. 21, No. 1, p 73-79, January, 1985. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Statistical studies, *Rainfall, *Model studies, Model selection, Stochastic process, Estimation.

Development of parameter estimation and hypothesis testing procedures for stochastic rainfall models has become a critical problem of precipitation research. Maximum likelihood procedures were developed for parameter estimation and model selection that apply to a large class of point process models that have been used to model rainfall occurrences, including Cox processes, Neyman-Scott processes, and renewal processes. The model selection procedure, based on likelihood ratios, is designed to determine which of two competing classes of point processes provides a better model for a given data set. The statistical inference procedures are based on a stochastic intensity. The likelihood function of a point process has a simple expression in terms of the stochastic intensity. The main result of this paper is a recursive procedure of computing stochastic inten-

sities; the procedure is applicable to a broad class of point process models, including renewal Cox process with Markovian intensity processes and an important class of Neyman-Scott processes. A Neyman-Scott process for which the cluster size distribution is Poisson and the distribution (relative) locations of cluster members is exponential can be represented a Cox process: the directing process is a Markov process. The model selection procedure proposed, which is based on likelihood ratios, allows direct comparison of two classes of point processes to determine which provides a better model for a given data set. The estimation and model selection procedures are applied to two data sets of simulated Cox process arrivals and a data set of daily rainfall occurrences in the Potomac River basin. The interference procedures developed cannot be generalized to point processes in the plane or higher dimensions or to space-time rainfall models. Intensity-based inference procedures are intimately tied to ordering properties of the real line. (Moore-IVI)
W85-04794

ESTIMATING THE PARAMETERS OF A CUBE ROOT NORMAL DISTRIBUTION FROM REDUCED SAMPLE DATA,
Idaho Univ., Moscow. Dept. of Mathematics and Applied Statistics.
C. J. Potratz, R. K. Steinhorst, and C. L. Hanson.
Water Resources Research, Vol. 21, No. 1, p 89-90, January, 1985. 1 Tab, 5 Ref.

Descriptors: *Rainfall, *Estimating, *Distribution, Rainfall distribution, Mathematical equations, Simulation.

A procedure is presented which provides estimates for the parameters of a cube root normal distribution, using only the sample mean and variance of the untransformed data. The technique employs Newton's algorithm and yields method of moments estimates which can be applied when only aggregated data are available. When 40 year records of monthly precipitation from certain Idaho stations were studied it was found that a cube root normal distribution provided a good fit. For certain other locations, monthly figures were not available but the long term monthly average and standard deviation were known or were interpolated from maps. The goal was to simulate monthly precipitation data for all locations consistent with the long term averages and the cube root normal model. (Baker-IVI)
W85-04796

2C. Snow, Ice, and Frost

GLACIER SURGE MECHANISM: 1982-1983 SURGE OF VARIEGATED GLACIER, ALASKA,
California Inst. of Tech., Pasadena. Div. of Geological and Planetary Sciences.
B. Kamb, C. F. Raymond, W. D. Harrison, H. Engelhardt, and K. A. Echelmeyer.
Science, Vol. 227, No. 4686, p 469-479, February, 1985. 12 Fig, 41 Ref. NSF grants DPP-82-09824, DPP-82-00725, EAR-79-19424, EAR-79-19530.

Descriptors: *Glaciers, *Variegated Glacier, *Alaska, *Glacier surges, Glaciohydrology, Basal pressure, Basal sliding.

The recurrence period of surging of Variegated Glacier, Alaska, is about 17 to 20 years. Monitoring of the glacier beginning in 1973 revealed year to year thickening of ice in the middle and upper part of the glacier and a thinning in the lower part. In the middle glacier, the ice flow velocity approximately doubled between 1973 and 1981, and in the upper glacier it approximately quadrupled. Summertime flow velocities in 1981 were 0.4 to 1.0 m/day in the upper glacier and 0.1 to 0.2 m/day in the lower glacier; the terminal lobe was essentially stagnant. Starting in 1978, wintertime flow velocities began to show an anomalous increase, small but definite, which suggested that increased basal sliding was now occurring in winter as well as in summer. Onset of the surge began in January 1982 and was detected by a marked increase in seismic icequake activity picked up by a seismometer located on bedrock 0.5 km north of the upper glacier. The velocity in the upper glacier peaked at 10.4 m/day on 26 June and dropping to within less than half that value in a few hours. The motion thereafter was pulsatory and declining; the surging seemed to have stopped in August and September. The velocity peaked again in January 1983 at 5 to 7 m/day and in mid-June at 15 m/day. By 26 July the velocity had decreased to 0.2 m/day in the upper glacier. The hundredfold speedup in glacier motion in a surge of the kind that took place in Variegated Glacier in 1982-1983 is caused by the buildup of high water pressure in the basal passageway system, which is made possible by a fundamental and pervasive change in the geometry and water-transport characteristics of this system. Increased basal water pressure causes increased sliding by reducing friction and by increasing basal cavitation, and also by exerting a direct effect of the integral of pressure. The role of high water pressure in causing the rapid basal sliding motion in the surge of a glacier is analogous to its proposed role in the mechanics of overthrust faulting and landslides. (Collier-IVI)
W85-04472

THICKNESS OF ICE ON PERENNIALLY FROZEN LAKES,
National Aeronautics and Space Administration, Moffett Field, CA. Ames Research Center.
C. P. McKay, G. D. Clow, R. A. Wharton Jr., and S. W. Squyres.
Nature, Vol. 313, No. 6003, p 561-562, February, 1985. 2 Fig, 28 Ref.

Descriptors: *Ice cover, *Lakes, *Victoria Land, *Antarctic, Temperature effects, Freezing, Model studies, Salinity, Energy balance, Ablation.

A simple energy balance model was used to explain the observed ice thickness on perennially frozen lakes in the dry valleys of southern Victoria Land. The model uses the measured ablation rate of 30 cm/yr. The model predictions were shown to be consistent with measurements of the ice cover thickness, which in the dry valley lakes of southern Victoria Land range from 3.6 to 6.5 m. The effect of ablation in determining the thickness of the ice cover depends on the availability of liquid water beneath the ice as the source for new ice, and also on the latent heat released at the underside of the ice cover on freezing. (Baker-IVI)
W85-04883

AIRBORNE MICROWAVE MEASUREMENTS OF THE SOUTHERN GREENLAND ICE SHEET,
Massachusetts Univ., Amherst.
C. T. Swift, P. S. Hayes, J. S. Herd, W. L. Jones, and V. E. Delnore.
Journal of Geophysical Research, Vol. 90, No. B2, p 1983-1994, February, 1985. 10 Fig, 14 Ref.

Descriptors: *Remote sensing, *Microwaves, *Ice sheets, *Greenland, Ice lenses, Ice glands, Density, Glaciers, Anisotropy.

Microwave remote sensing measurements were collected over Greenland with the NASA C-130 aircraft used as a platform. The principal instruments were a C band radiometer and an X band scatterometer, which simultaneously collected both active and passive microwave remote sensing data. The data collected fully support the conclusions drawn by others that volume scattering from subsurface ice lenses and glands is the major influence on the microwave signature. Both the thermal emission and radar backscattering results are self-consistent with rather simple theories of volume scattering. The remote sensing measurements also provide a relative measure of the number density of scatterers; however, additional theoretical work is required to establish the cross section per scatterer in order to measure absolute number density. Along this avenue of thought, the data rule out Rayleigh scattering and strongly support a high frequency model. The measured anisotropy over the ice cap appears to be a new observation, and future exploitation of remote sensing techniques may provide information relating to the average shape of subsurface patterns and information relative to glacial flow. (Baker-IVI)
W85-04962

2D. Evaporation and Transpiration

WATER-TABLE CONTRIBUTION TO ALFALFA EVAPOTRANSPIRATION AND YIELDS IN SANDY SOILS,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
L. C. Benz, E. J. Doering, and G. A. Reichman.
Transactions of the American Society of Agricultural Engineers, p 1307-1312, 1984. 2 Fig, 4 Tab, 19 Ref.

Descriptors: *Water table, *Alfalfa, *Crop yields, *Sandy soil, *Evapotranspiration, Lysimeters, Irrigation practices, Water use efficiency, Rainfall, Subsurface irrigation.

In a lysimeter experiment, four constant water-table depths and three irrigation levels were evaluated for their effects on annual alfalfa yields and growing season evapotranspiration (ET) for 2 years. Alfalfa yields were depressed and ET was excessive for the shallow (46 cm) water-table depth. The 2 years of cropping data, after an alfalfa establishment year, and excluding data from the shallowest (46 cm) water-table depth, indicated that growing-season ET values were 55.3, 64.2, and 69.3 cm with average yields of 14.0, 14.9, and 14.4 t/ha and water use efficiency (WUE) values of 4.0, 4.1, and 4.9 cm/t/ha respectively for 0.3, 0.8 and 1.3 irrigation levels (combinations of surface-applied irrigation plus rainfall that were equivalent to 0.3, 0.8, and 1.3 times calculated ET). The water table, through subirrigation, provided a sizable contribution to actual ET, which increased as level of surface irrigation decreased. Subirrigation provided 38.4% of total ET for the low (0.3) irrigation level, compared to only 0.6% of total ET for the high (1.3) irrigation level. (Author's abstract)
W85-04727

2E. Streamflow and Runoff

RESERVOIR STORAGE EQUATION EXPERIMENTALLY VERIFIED,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
W. H. Hager, R. Sinniger, and J. M. Regamey.
International Water Power and Dam Construction, Vol. 36, No. 11, p 44-48, November, 1984. 9 Fig, 9 Ref.

Descriptors: *Reservoir storage, *Mathematical equations, *Hydrographs, Reservoirs, Flow characteristics, Flow measurement, Model studies.

The well-known storage model for a reservoir with non-prismatic shape has been experimentally verified. The results of a simplified storage model were compared with observations and this model was applied to real situations and the results of each were compared. An equation is provided which allows an accurate prediction to be made of the resulting reservoir outflow hydrograph. Maximum deviations between analysis and observations have always been less than 5% with respect to the maximum inflow discharge. The peak outflow discharge has a deviation of less than 3% of the maximum inflow discharge. Deviations must be attributed to inertial effects acting on the water. The simplified model can also be applied to real flow situations by taking account approximately of the effective inflow hydrograph. The parameters measuring the time to peak of inflow hydrograph, maximum inflow discharge, and the inflow hydrograph shape parameter allow for a fair adjustment to be made. When compared with the accuracy of the prediction of the inflow hydrograph, the simplified reservoir storage model usually yields accurate enough solutions, and therefore may be considered as an effective and simple tool for design purposes. (Baker-IVI)
W85-04416

INVESTIGATION OF THE STABILITY OF RIVER AND CANAL CHANNELS,

For primary bibliographic entry see Field 2J.
W85-04422

FUNDAMENTAL DIFFERENTIAL EQUATION OF FLOW OF A FLUID WITH A VARIABLE MASS IN THE CASE OF BILATERAL WATER DIVERSION,
N. E. Markova.
Hydrotechnical Construction, Vol. 18, No. 4, p 153-162, April, 1984. 6 Fig, 3 Ref. Translated from Gidrotecknickeskoe Stroitel'stvo, No. 4, p 17-22, April, 1984.

Descriptors: *Open channel flow, *Differential equations, *Diversion, Hydraulics, Flow discharge, Bilateral diversion, Mathematical equations, Steady flow.

The problem of division of flow is one of the urgent and most complicated problems of modern hydraulics. A fundamental differential equation of steady flow of a fluid with a variable mass is derived. This equation makes it possible to solve many theoretical and practical problems arising in the case of bilateral diversion of water in open channels. Several different variants are examined including bilateral symmetric division of flow, symmetric division of the flow, bilateral nonsymmetric division of flow, and bilateral nonsymmetric division of flow. At the site of division of flow a change in certain depths occurs related to the law of variation of discharge. The normal line and the critical depths line will be curvilinear. For bilateral symmetric diversion of water the specific energy of the basic flow before division is greater than the half-sum of the specific energies of the dividing flows. (Baker-IVI)
W85-04428

MASINGA DAM IN KENYA,
Watermeyer, Legge, Piesold and Uhlmann, Braamfontein (South Africa).
For primary bibliographic entry see Field 8A.
W85-04471

TREES SCARS TO DETERMINE THE FREQUENCY AND STAGE OF HIGH MAGNITUDE RIVER ICE DRIVES AND JAMS, RED DEER, ALBERTA,
Calgary Univ. (Alberta). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W85-04589

SIMPLEST APPROXIMATE COMPUTATION OF DAM-BREAK WAVES (DIE EINFACHSTE NAHERUNGSBERECHNUNG VON DAMM-BRUCHWELLEN),
Ingenieurburo, Aarau (Switzerland).
For primary bibliographic entry see Field 8B.
W85-04630

RELATIONSHIPS BETWEEN WOODY DEBRIS AND FISH HABITAT IN A SMALL WARMWATER STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
P. L. Angermeier, and J. R. Karr.
Transactions of the American Fisheries Society, Vol. 113, No. 6, p 716-726, November, 1984. 3 Fig, 4 Tab, 54 Ref. EPA grants R806391 and CR810745.

Descriptors: *Aquatic habitats, *Fish, *Debris, Ecological effects, Species composition, Animal behavior, Invertebrates, Benthos, Litter.

Abundance of woody debris was manipulated in a small Illinois stream to determine the importance of this material to fish. When a stream reach was divided along midchannel, and debris was added to one side, but removed from the other, fish and benthic invertebrates were usually more abundant on the side with woody debris than on the cleared side. In further experiments during a low-flow year (1980), debris removal was followed by rapid decreases in water depth and occurrence of benthic organic litter, and increases in current velocity and proportion of sand bottom. These changes were less apparent in unaltered reaches during 1980, and in all reaches during 1981, which was a high-flow year. Artificial debris was colonized by many invertebrates, including chironomids, trichopterans, and ephemeropterans. Most large fish (age 2+) avoided reaches without debris, whereas some smaller fish (such as johnny darter) preferred them; preferences for reach treatments were stronger in 1980 than in 1981. The adaptive significance of associations between fish and woody debris appeared more closely related to the advantages of camouflage than those of increased food availability or protection from strong currents. Extensive removal of woody debris may disrupt structure and function in small streams, especially low-gradient ones. If the biological integrity of stream resources is to be maintained despite agricultural and urban uses, less disruptive management protocols will need to be employed. (Author's abstract)
W85-04679

RUNOFF AND SEDIMENT TRANSPORT WITHIN AND FROM SMALL AGRICULTURAL WATERSHEDS,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W85-04734

MARKOV FLOW MODELS AND THE FLOOD WARNING PROBLEM,
Arizona Univ., Tucson. Dept. of Systems and Industrial Engineering.
S. Yakowitz.
Water Resources Research, Vol. 21, No. 1, p 81-88, January, 1985. 4 Fig, 2 Tab, 34 Ref. NSF grants Int. 78-12184, ENG 78-07358, CME 7905010 and CEE 8110778.

Descriptors: *Flood warnings, *Markov flow models, Warnings, Flood forecasting, River flow, Decision making, Model studies.

The flood warning problem is a situation where the decision maker must decide whether to release a flood warning, the decision being based on the water level, the past flow record, and the losses associated with the two types of mistakes (issuing a warning when no flood occurs, and not providing a warning for a flood). It is argued that outside the Gaussian assumption, standard time series methodology is inappropriate for the flood warning problem. A nonparametric inference procedure is described which converges to the optimal decision function for the flood warning problem as the length of the historical record increases for any stationary G sub 2-ergodic Markov process. Under additional assumptions, rates can be established and shown to be optimal in a certain sense. The new methodology is compared with autoregressive moving average predictors on simulated and river flow data. For a given data base it appears impossible to improve significantly on the asymtotic properties of the proposed methodology without invoking more stringent modeling assumptions. (Moore-IVI)
W85-04795

EXTENSION OF A STREAMFLOW TIME SERIES BY REGRESSION (VERLANGERUNG EINER ZEITREIHE DES DURCHFLUSSES MIT HILFE EINES REGRESSIONSMODELLS),
M. Domokos, and G. Kovacs.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 3, p 85-89, July, 1984. 6 Fig, 8 Ref.

Descriptors: *Streamflow, *Zala River, *Hungary, *Linear regression, Time series analysis, Flow discharge, River flow, Precipitation, Model studies, Base flow.

The runoff from 45% of the 5774 sq km large catchment of the Lake Balaton (Hungary) is drained by the Zala river to the lake. In order to protect Lake Balaton from eutrophication, a retention marsh system will be built, as a reconstrution of the earlier swampy area called Kis-Balaton, along the mouth reach of the Zala River. A long time-series of discharges at the mouth of the river is necessary for dimensioning and operational planning of this system. A flume at Fenekpuszta, near the mouth, was only constructed in 1975. Prior to this date the backwater effect from the lake prevented any measurement of the entering flow. The discharge record is continuous and reliable since 1 July 1975. Through late 1980, the discharge through the flume was measured on 788 occasions. The problem consisted thus in deriving a sound estimate of the most likely discharges which had passed the mouth of the Zala river before 1 July 1975. The five and half-year record of the Fenekpuszta gauging section, the streamflow record of the nearest gauging section (Zalaapati) on the Zala river (continuous since January 1952) and precipitation data for the sub-catchment between the two gauging sections were used to extend the record. The data generation model uses a multivariate linear regression approach to produce separately the base flow, the direct surface runoff, and the reconstructed Fenekpuszta discharge values as the sum of both. The verified model could be used to reconstruct the discharge data of the Fenekpuszta gauge over the period January 1, 1952 to June 30, 1975. (Moore-IVI)
W85-04807

CONTRAST IN STREAM-CHANNEL RESPONSE TO MAJOR STORMS IN TWO MOUNTAINOUS AREAS OF CALIFORNIA,
Geological Survey, Menlo Park, CA.
For primary bibliographic entry see Field 2J.
W85-04836

WATER QUALITY OF THE COLORADO RIVER SYSTEM: HISTORICAL TRENDS IN CONCENTRATION LOAD, AND MASS FRACTION OF INORGANIC SOLUTES,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. D. Moody, and D. K. Mueller.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-84-9, January 1984. 60 p, 14 Fig, 19 Tab, 16 Ref, 16 Append.

Descriptors: *Saline water, *Water quality, *Dissolved solids, *Reservoirs, Seasonal variation, Colorado River, Lake Mead, Lake Powell, Colorado, Utah.

A systematic change in salt loading in the lower Colorado River may manifest itself as a long-term shift in the concentration, load, or mass fraction of major solutes. In this study, shifts were identified using trend analyses and by comparing mean values before and after major reservoir development. Representative monthly solute concentration and streamflow values were computed for 15 major gage stations. For the 12 stations with sufficient data prior to major flow regulation, trends were identified using regression models. Significant decreases were found for magnesium, sodium, and sulfate at nine stations, accounting for an overall reduction of 2 mg/L/yr for the Lake Mead inflow during the months from December to March. After construction of the Colorado River Storage Project reservoirs, the seasonal variability in salinity was reduced at all downstream stations; concentrations generally decreased in May and June, and increased during the August-March season. Few trends were evident after flow regulation. In addition to reservoir construction, several activities of man were hypothesized as causes of identified trends and mean value changes. The major reservoirs, Lakes Powell and Mead, masked the effects of all other activities. No significant trends in load were found for the station below Lake Mead after 1965.
W85-04942

2F. Groundwater

POTENTIAL EFFECTS ON GROUND WATER OF A HYPOTHETICAL SURFACE COAL MINE IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
For primary bibliographic entry see Field 4C.
W85-04418

MULTISTAGE MODEL FOR THE DEVELOPMENT OF HYDROCHEMICAL ZONATION IN CHALK GROUND WATERS,
Toronto Univ. (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W85-04634

DISTRIBUTION OF CARBONATES, BICARBONATES, AND PH VALUES IN GROUND WATER OF THE NILE DELTA REGION, EGYPT,
Cairo Univ., Giza (Egypt). Dept of Chemistry.
For primary bibliographic entry see Field 2K.
W85-04638

BRACKISH WATER IN UNSATURATED CONFINING BEDS AT A TEXAS LIGNITE MINE,
Texas Univ. at Austin. Bureau of Economic Geology.
A. R. Dutton.
Ground Water, Vol. 23, No. 1, p 42-51, January-February, 1985. 8 Fig, 4 Tab, 31 Ref.

Descriptors: *Confining beds, *Brackish water, *Geohydrology, *Texas, Vadose water, Chlorides, Dissolved solids, Strip mines, Land reclamation, Groundwater, Claystone, Mudstone.

Deposits of low permeability are hydrologic barriers between reclaimed land and juxtaposed aquifers and should limit the impact of mining on ground-water quality. Claystone and mudstone in argillaceous facies of the Calvert Bluff Formation (lower Eocene, Wilcox Group) function as confining beds in the East Texas Basin. In the subsurface and at the outcrop, water in argillaceous deposits is brackish to saline. Samples of vadose water from the outcrop of confining beds at the Big Brown lignite mine in Freestone County, Texas, have a chloride concentration of up to 3,500 mg/l and total dissolved solids of up to 8,000 mg/l. Groundwater composition evolved from Eocene sea water by seven- to nine-fold dilution with rain water. Ion exchange, pyrite oxidation, and calcite dissolution further modified water composition. The amount of recharge through the vadose zone where confining layers crop out is probably negligible over an extremely long time. Meteoric flushing in reclaimed land at the surface mine is many times greater than that in unmined mudstone deposits, and the chemical composition of vadose water in reclaimed land is changed by further dilution and water-rock reactions. (Author's abstract)
W85-04639

ROLE OF SPECIFIC YIELD IN GROUNDWATER RECHARGE ESTIMATIONS: A NUMERICAL STUDY,
Kansas State Geological Survey, Lawrence.
M. Sophocleous.
Ground Water, Vol. 23, No. 1, p 52-58, January-February, 1985. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Specific yield, *Groundwater recharge, Mathematical models, Capillary fringe, Groundwater movement, Saturated flow, Unsaturated flow.

This paper numerically demonstrates and quantifies the importance of capillary-fringe and variable specific yield phenomena in ground-water recharge estimations. A one-dimensional numerical experiment consisting of a soil either with a capillary fringe or without it was set up using a finite-element code. A prescribed infiltrating flux was superimposed on top of the soil column, and the resulting unsaturated-saturated water flow was observed. By assuming a single value for specific yield, recharge is usually overestimated. For two cases considered in this study, the errors involved in ground-water recharge estimations by using such an assumption ranged from 88 to 330 times the simulated recharge, when variable specific yield is considered. This study also clearly demonstrates the effect of a constant specific yield value on the behavior of the water table rise, the total amount of which as well as the rate of such rise are underestimated under that assumption. In addition, under that assumption, the timing of the water table rise is out of phase with the timing of recharge events. (Author's abstract)
W85-04640

LGWRES - LIFE OF GROUND-WATER RESERVES,
Ministry of Planning, Riyadh (Saudi Arabia).
For primary bibliographic entry see Field 4B.
W85-04643

GALERKIN FINITE-ELEMENT PROGRAM FOR SIMULATING UNSATURATED FLOW IN POROUS MEDIA,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
R. Khaleel, and T.-C. Yeh.
Ground Water, Vol. 23, No. 1, p 90-96, January-February, 1985. 1 Fig, 8 Ref. 1 Append.

Descriptors: *Unsaturated flow, *Computer programs, *Porous media, Simulation, Mathematical studies, Groundwater movement.

Unsaturated flow typically involves nonuniform, time-dependent moisture contents and flow fields. The partial differential equation governing unsaturated flow in porous media is nonlinear, and not readily amendable to accurate analytical solutions. In the Galerkin approach, the dependent variable (the pressure head) is approximated by a series of basis (or shape) functions and associated time-dependent coefficients. A Galerkin finite-element solution of the one-dimensional unsaturated flow equation is developed using a linear basis or shape functions. A fully documented listing of the FORTRAN program is provided. Material balance error summaries are presented to demonstrate the accuracy of the numerical scheme. Excellent agreement of simulated results with other existing numerical solutions using the Galerkin scheme was found. (Moore-IVI)
W85-04645

ARSENIC SPECIATION IN SOIL-PORE WATERS FROM MINERALIZED AND UNMINERALIZED AREAS OF SOUTH-WEST ENGLAND,
Thames Polytechnic, London (England).
For primary bibliographic entry see Field 2K.
W85-04662

GROUNDWATER SEEPAGE AND THE WATER BALANCE OF A CLOSED, FRESHWATER, COASTAL DUNE LAKE: LAKE WINDERMERE, JERVIS BAY,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
G. Jacobson, and A. W. Schuett.
Australian Journal of Marine and Freshwater Research, Vol. 35, No. 6, p 645-654, 1984. 7 Fig, 3 Tab, 7 Ref.

Descriptors: *Groundwater recharge, *Water level fluctuations, *Lake Windermere, *Australia, *Jervis Bay, Dune lakes, Lakes, Groundwater level.

Lake Windermere is a closed, freshwater dune lake in the Commonwealth Territory of Jervis Bay, Australia. It is subject to cyclical water-level fluctuations of up to 12 m in response to climatic variations with a period of several years. In the Jervis Bay Territory, groundwater occurs both in unconsolidated sand and in jointed sandstone. Groundwater flows westwards from the lake through a highly permeable Pleistocene sand aquifer. An approximate water balance indicates that groundwater seepage is the most significant component (84%) of the outflow from the lake, whereas surface streams are the most significant component (89%) of the inflow to the lake. There is clearly a large amount of groundwater in storage in the Pleistocene sand aquifer and thus there is considerable scope for water supply development by pumping from bores, should the volume of lake water again fall to a critically low level. (Collier-IVI)
W85-04698

MACROINVERTEBRATES IN A SEWAGE-POLLUTED AQUIFER,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
For primary bibliographic entry see Field 5C.
W85-04720

STREAM WATER LEVELS AFFECT FIELD WATER TABLES AND CORN YIELDS,
Agricultural Research Service, Florence, SC.
C. W. Doty, J. E. Parsons, A. Nassehzadeh-Tabrizi, R. W. Skaggs, and A. W. Badr.
Transactions of the American Society of Agricultural Engineers, p 1300-1306, 1984. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Water table, *Crop yield, *Corn, *Drawdown, *Mitchell Creek, *North Carolina, *Edgecombe County, *Pitt County, Flow control, Dams, Streamflow, Channels.

A section of land about 1800 m wide and 4000 m along Mitchell Creek in Edgecombe and Pitt Counties, North Carolina, was studied for three years, 1980, 1981, and 1982. During 1980 and 1981 the deep channel in these sandy soils caused a water table drawdown of about 3 m near the stream. The water table was affected 884 m away. Corn yields near the creek were one-half those at 800 m from the creek. Stress-day indices varied inversely with yield. In 1982 a fabric dam, filled with water that automatically controls water levels in the creek and allows floods to pass, was installed in the creek. Stream water level control caused a significant rise in water table levels in the fields, and corn yields were 23% more than yields without water table control within 488 m of Mitchell Creek. This increased value of yield in 1982 will pay for the high costing prototype dam in about 15 years if these results continue. (Author's abstract)
W85-04726

FIELD METHOD TO DETERMINE UNSATURATED HYDRAULIC CONDUCTIVITY USING FLOW NETS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
For primary bibliographic entry see Field 2G.
W85-04791

STOCHASTIC MODELING OF GROUNDWATER FLOW BY UNCONDITIONAL AND CONDITIONAL PROBABILITIES: THE INVERSE PROBLEM,
Tel-Aviv Univ. (Israel). Faculty of Engineering.
G. Dagan.
Water Resources Research, Vol. 21, No. 1, p 65-72, January, 1985. 3 Fig, 13 Ref, 1 Append.

Descriptors: *Groundwater movement, *Stochastic process, *Model studies, Transmissivity, Hydraulic head, Mathematical equations, Groundwater recharge, Aquifers.

The inverse problem is defined here as follows: determine the transmissivity at various points, given the shape and boundary of the aquifer and recharge intensity and given a set of measured log-transmissivity Y and head H values at a few points. The log-transmissivity distribution is regarded as a realization of a random function of normal and stationary unconditional probability density function (pdf). The solution of the inverse problem is the conditional normal pdf of Y, conditioned on measured H and Y, which is expressed in terms of the unconditional joint pdf of Y and H. The problem is reduced to determining the unconditioned head-log-transmissivity covariance and head variogram for a selected Y covariance which depends on a few unknown parameters. This is achieved by solving a first-order approximation of the flow equations. The method is illustrated for an exponential Y covariance, and the effect of head and transmissivity measurements upon the reduction of uncertainty of Y is investigated systematically. It is shown that measurement of H has a lesser impact than those of Y, but a judicious combination may lead to significant reduction of the predicted variance of Y. Possible applications to real aquifers are outlined. (Author's abstract)
W85-04793

2G. Water In Soils

EVALUATION TECHNIQUE FOR GROUND WATER QUALITY BENEATH URBAN RUNOFF RETENTION AND PERCOLATION BASINS,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
H. I. Nightingale, D. Harrison, and J. E. Salo.
Ground Water Monitoring Review, Vol. 5, No. 1, p 43-50, 1985. 6 Fig, 4 Tab, 17 Ref.

Descriptors: *Groundwater, *Soil water, *Water quality, *Sampling devices, *Urban runoff, *Percolation basins, *Fresno, *California, Water sampling, Observation wells, Shallow wells, Catchment basins.

The Fresno Metropolitan Flood Control District (FMFCD) in California is using small (<4 ha) retention/recharge basins for the management and conservation of urban runoff because of a lack of natural water courses. In addition to storm runoff, some basins are selected to receive imported surface water for groundwater recharge. A sampling program was conducted of water percolating through the soil profile during the recharge events and the upper zone of the unconfined aquifer directly beneath the basin floor; soil and water samples were taken at five FMFCD basins. Obtaining a suitable size sample of the soil solution for chemical analysis from the unsaturated (vadose) zone requires some type of porous material to separate the solid soil phase from the liquid phase. A vadose zone water extractor was constructed with Teflon and a porous ceramic suction cup. The extractor can usually be retrieved if the access well and well head as described are used; the ceramic cup can then be replaced if necessary and the extractor reused at another site. The water extractor is not suitable for obtaining samples for analysis of highly volatile pollutants. Up to four of these water extractors were used to monitor the quality of percolating urban runoff water and top of the ground water table (20 to 30 m) beneath the retention/recharge basins. Presence of water in the basins requires constructing a sealed borehole annular space, a watertight well head, and seal around the Teflon access tubes to the extractor at a control box containing the valves in the access tubes. Sampling percolating soil water in the unsaturated zone was dependent on having a recharge event of sufficient magnitude. Sampling the water in the saturated zone was easy unless the regional water table fell below the ceramic cup during the summer months of high pumping. (Collier-IVI)
W85-04417

COMPARISON OF FIELD- AND LABORATORY-MEASURED AND PREDICTED HYDRAULIC PROPERTIES OF A SOIL WITH MACROPORES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
J. A. Field, J. C. Parker, and N. L. Powell.
Soil Science, Vol. 138, No. 6, p 385-396, December, 1984. 6 Fig, 2 Tab, 21 Ref.

Descriptors: *Macropores, *Soil hydraulic properties, Matric tension, Soil water, Soil saturation, Conductivity, Soil porosity, Root channels, Hydraulic properties.

Soil hydraulic properties were determined in situ by the instantaneous profile method on three 3-m square plots of Dothan soil (plinthic paleudult, fine-loamy siliceous, thermic). Simultaneous measurements of matric tension and moisture content with depth during drainage were made with tensiometers and a field-calibrated neutron probe. Unsaturated conductivity values calculated from the in situ data range within an order of magnitude for corresponding horizons in the three plots. Variability between plots was greatest at moisture contents near saturation. The large data scatter is attributed to soil heterogeneity and to nonuniform drainage resulting form interaggregate porosity and root channels in the soil profile. Unsaturated conductivities calculated from the instantaneous profile test were compared with values predicted by two cut-and-random-rejoin-type pore structure models using laboratory- and field-measured moisture retention data. Laboratory measurements of moisture retention characteristics were made by pressure desorption of 54-mm diameter 'undisturbed' cores. The models of Jackson (1972. Soil Sci. Soc. Am. Proc., 36:380-383) and van Genuchten (1980. Soil Sci. Soc. Am. J., 44:892-898) were both successful in predicting unsaturated conductivities within the scatter of in situ values when field-measured moisture retention data were used and the mean in situ saturated conductivity was employed as a matching point. Correspondence between predicted and in situ conductivities was poorer when using laboratory retention data, reflecting difficulties in obtaining representative undisturbed core samples. (Author's abstract)
W85-04617

SOIL MOISTURE REGIMES OF THREE CONSERVATION TILLAGE SYSTEMS,
Wisconsin Univ.-Madison. Dept. of Soil Science.
M. D. Johnson, B. Lowery, and T. C. Daniel.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1385-1390 and 1395, September-October, 1984. 10 Fig, 3 Tab, 16 Ref.

Descriptors: *Soil water, *Conservation tillage, *Soil conservation, *Tillage, *Cultivation, Chisel plowing, No-till, Moldboard plowing, Recharge.

Comparison of three conservation tillage systems, chisel plowing (CH), till-plant (TP) and no-till (NT), to conventional moldboard plowing (CN) indicates soil moisture advantages with conservation tillage vary. Volumetric water content (3-year average, 0-76 mm depth) at planting was 0.324, 0.279, 0.267 and 0.246 cu m/cu m for NT, CH, TP, and CN, respectively. Average 3-year water content in the 0-0.25 m zone for weekly measurements during the growing season was 0.320, 0.309, 0.300, and 0.297 cu m/cu m for NT, CH, CN and TP, respectively. Soil moisture was higher in the NT treatment during most of the growing period. However, during a heavy rain period (93 mm), profile recharge in the CN, TP and NT treatments was 34, 34 and 44% less than for the CH treatment, respectively. Less water was removed from the 0.50-1.0 m zone of NT during extensive water depletion. For this soil with a 6-% slope, the NT treatment displayed the least water fluctuation during drying periods. (Author's abstract)
W85-04737

CORN SILAGE RESPONSE TO SUBSURFACE DRAINAGE ON ALLUVIAL SOIL,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
R. L. Bengtson, C. E. Carter, V. McDaniel, and B. E. Halverson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1391-1395, September-October, 1984. 6 Fig, 5 Tab, 11 Ref.

Descriptors: *Drainage, *Subsurface drainage, *Louisiana, *Precipitation, *Water table, Crop yield, Corn, Soil water.

Severe problems with high water tables exist in Southern Louisiana due to precipitation and low lying, nearly level, topography. Although surface drainage systems are used throughout the region, practically no use has been made of subsurface drainage. A subsurface drainage experiment on clay loam soil near Baton Rouge, Louisiana, was conducted from 1980-1983. The experiment consisted of four plots, of which two were both surface and subsurface drained; subsurface drainage was accomplished with 10 cm diameter, corrugated, perforated, polyethylene drain tubes installed one m below the soil surface on a grade of 0.10%. The other two plots contained surface drainage only. Corn silage was grown each year; average yields from the subsurface drained plots were 84% higher than the yields from plots with surface drainage only. The growing season high water table stress as quantified by SEW sub 30 had a highly significant effect on corn silage yields. SEW sub 30 values for the surface-only drained plots were 323.7, 200.6, and 462.7 cm-days for 1981, 1982, and 1983, respectively; the SEW sub 30 values for the subsurface drained plots were 0, 0, and 13.0 for the same years. Subsurface drainage effectively lowers the water table in flat topography, clay loam alluvial soil in areas with high growing season rainfall, thus controlling excess water in the root zone. Subsurface drainage thereby very significantly increases corn yields in areas with clay loam alluvial soil where a high water table above the 30 cm depth occurs during the growing season. (Collier-IVI)
W85-04738

HYDRAULIC CONDUCTIVITY MEASURED ELECTRONICALLY IN AN AUGER HOLE,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
C. E. Carter, F. T. Wratten, V. McDaniel, and B. Halverson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1400-1404, 1984. 6 Fig, 1 Tab, 8 Ref.

Descriptors: *Permeability coefficient, *Measurement instrumentation, *Augur holes, Subsurface drainage, Soil properties, Computers.

An electronic system for measuring hydraulic conductivity in a single auger hole was developed, laboratory and field tested, and put into use. The system consisted of a capacigage probe and transmitter, a digital voltmeter, a desktop computer with a real time clock, and a plotter. The capacigage probe's transmitter was modified so that the water level surrounding the probe inside a metal pipe was indicated by DC volts. The computer was programmed to read the voltage, convert to water levels and calculate the hydraulic conductivity of the soil based on the rate at which the water level increased with time. The data were recorded on cassette and paper tape, and plotted on a graph as the data were taken in the field. The system provides an improved method for measuring water levels in an auger hole which in turn improves the quality of hydraulic conductivity measurements. (Baker-IVI)
W85-04740

MULTIPHASE APPROACH TO THE MODELING OF POROUS MEDIA CONTAMINATION BY ORGANIC COMPOUNDS; I. EQUATION DEVELOPMENT,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-04787

MULTIPHASE APPROACH TO THE MODELING OF POROUS MEDIA CONTAMINATION BY ORGANIC COMPOUNDS; 2. NUMERICAL SIMULATION,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W85-04788

INFILTRATION IN SWELLING SOILS,
Instituto Nacional de Investigaciones Agrarias, Cordova (Spain). Dept. de Plantas Oleaginosas.
J. V. Giraldez, and G. Sposito.
Water Resources Research, Vol. 21, No. 1, p 33-44, January, 1985. 14 Fig, 6 Tab, 67 Ref.

Descriptors: *Swelling soils, *Infiltration, Mathematical equations, Ponding, Permeability coefficient, Model studies, Soil physical properties.

Infiltration phenomena in swelling soils were investigated theoretically. The approach taken consisted of applying both approximate analytical techniques and conventional finite difference numerical methods to study the generalized Richards equation for one-dimensional infiltration in a swelling soil. Equations were derived for the ponding time and the postponding infiltration rate that are generalizations of the Parlange-Smith model expressions for rigid soils. Ponding times for swelling soils were shorter than those for nonswelling analogs, and postponding infiltration rates in swelling

soils approach zero instead of becoming equal to the hydraulic conductivity, as in rigid soils. These results were confirmed, both qualitatively and quantitatively, with the numerical model, which also provided instantaneous moisture profiles and surface swelling predictions in agreement with field observations. The generalized three-parameter infiltration equation developed appears to be satisfactory for describing both laboratory and field data on swelling soils. The equation should prove to be a useful tool for hydrologists dealing with swelling soils who need to obtain parameters for use in runoff forecasting and vadose zone hydrology. (Moore-IVI)
W85-04790

FIELD METHOD TO DETERMINE UNSATURATED HYDRAULIC CONDUCTIVITY USING FLOW NETS,
New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience.
D. B. Stephens.
Water Resources Research, Vol. 21, No. 1, p 45-50, January, 1985. 9 Fig, 24 Ref. Bureau of Mines project G11511321, OWRT project B-073-NMEX.

Descriptors: *Permeability coefficient, *Flow nets, Hydraulic head, Aeration, Reservoirs, Hydraulic gradient, Soil water, Stream tube.

A practical new field method is proposed to evaluate hydraulic conductivity in partially saturated media near a water impoundment. The new method is an inverse procedure which utilizes a flow net constructed from the steady state total hydraulic head distribution around the water source. In the vicinity of constant head sources and downstream along any stream tube, wetness and conductivity generally decrease. Knowing the stream tube geometry and hydraulic gradient from the flow net, Darcy's law is used to determine unsaturated hydraulic conductivities within the stream tube relative to some segment of the stream tube where conductivity is known. This approach was used successfully to predict the unsaturated hydraulic conductivity which was input to two variably saturated numerical models, utilizing total hydraulic head fields generated by the models. This prodecure is also applied to pressure head and water content data collected in the field surrounding a constant head borehole infiltration test originally designed to determine only saturated hydraulic conductivity above the water table. For practical purposes the new procedure compares very favorably with (1) results of a field experiment to obtain unsaturated hydraulic conductivity in situ using the instantaneous profile method and (2) values of unsaturated conductivity calculated from field and laboratory measurements of water content and pressure head. (Author's abstract)
W85-04791

COARSE FRACTION OF SOILS: THE ROLE IT PLAYS IN PLANT NUTRITION, LIMING AND IRRIGATION,
F. Du P. Joubert.
Deciduous Fruit Growth (Cape Town), Vol. 32, No. 7, p 277,279, 281-285, 1982. 9 Tab, 4 Ref. (in Afrikaans and English).

Descriptors: *Plant nutrition, *Soil texture, *Particle size, Crops, Nutrients, Soil properties, Trace element, Lime, Irrigation.

The role of the coarse fraction of the soil in plant nutrition is considered. Specific attention is devoted to a discussion of soil analysis results which refer only to the soil fraction and not to the coarse fraction. Frequently the calcium and magnesium portions of the coarse fraction are overlooked in their contribution to fertilization or plant nutrition as the principal reason for liming is to raise a low pH to the optimum level for a specific crop. The role of the coarse fraction in irrigated soils is to help guard against the establishment of waterlogged conditions. (Baker-IVI)
W85-04823

PEDOLOGIC PROPERTIES OF NEW JERSEY TIDAL MARSHES,
Fruit and Food Technology Research Inst., Stellenbosch (South Africa).
For primary bibliographic entry see Field 2L.
W85-04955

RELATIONSHIPS AMONG OXYGEN FLUX, SOIL WATER TENSION, AND AERATION POROSITY IN A DRYING SOIL PROFILE,
Arkansas Univ., Fayetteville. Dept. of Agronomy.
G. V. Wilson, B. R. Thiesse, and H. D. Scott.
Soil Science, Vol. 139, No. 1, p 30-36, January, 1985. 4 Fig, 4 Tab, 19 Ref.

Descriptors: *Soil water tension, *Oxygen flux, *Aeration porosity, Soil aeration, Soil porosity, Drainage, Evaporation, Mathematical equations, Soil physical properties.

Managing the water status of soil for crop production and waste disposal requires knowledge of the oxygen availability in the profile. In this study a Captina silt loam (Typic Fragiudult) was nearly saturated and allowed to dry by drainage and evaporation. Oxygen flux and soil water tension were measured simultaneously on two bare plots during three drying cycles. At the end of the study, undisturbed cores were taken at three depth intervals in two plots and determined aeration porosity characteristics. The functional relationships between oxygen flux and aeration porosity determined from tensiometer data in the field and between tension and aeration porosity determined from the undisturbed cores were used to derive the mathematical relation between oxygen flux and soil water tension for the Captina profile. For the Captina soil, aeration porosity increased linearly with the natural logarithm of soil water tension. Similarly, the natural logarithm of oxygen flux was linearly related to aeration porosity. The combined equation describing oxygen flux as a function of soil water tension in the Captina soil constituted a power function. The description of the field data by the derived equations was excellent at all depths, and close agreement was found between the derived and the regression parameters of the power function relating oxygen flux and soil tension. (Author's abstract)
W85-04956

MOVEMENT OF WATER IN A PLINTHIC PALEUDULT USING A BROMIDE TRACER,
Georgia Univ., Athens. Dept. of Agronomy.
W. L. Carlen, H. F. Perkins, and R. A. Leonard.
Soil Science, Vol. 139, No. 1, p 62-66, January, 1985. 5 Fig, 3 Tab, 19 Ref.

Descriptors: *Soil water, *Plinthite, *Storm seepage, Bromides, Tracers, Soil saturation, Irrigation effects, Perched water table, Laterites.

Plinthite is a form of laterite that generally occurs in subsurface horizons as mottles or continuous phases of firm or hard iron-rich, red soil bodies. Mottles are considered plinthite after significant Fe segregation has occurred and they are capable of becoming irreversibly hardened upon repeated cycles of wetting and drying. Plinthite perches water during periods of excess soil moisture. Water movement in a plinthic soil in the Southern Coastal Plain was monitored over an 8-week period using a bromide tracer. Field investigations conducted on a Tifton loamy sand (Plinthic Paleudult) with a 4% slope indicate that much subsurface flow under saturated conditions occurs above and within plinthite. This partially accounts for seepage areas downslope in plinthic soils during periods of excess moisture as a result of rainfall or irrigation. Although plinthite may create a perched water table, it is not impervious to water movement. Water moves (albeit at a slow rate) through plinthic layers in interconnecting low-chroma soil bodies that have a lower bulk density and a higher percentage of pore space than surrounding plinthite and other high-chroma soil bodies. (Moore-IVI)
W85-04957

2H. Lakes

PHYTOPLANKTON IN A POLLUTED SUBARCTIC LAKE BEFORE AND AFTER NUTRIENT REDUCTION,
Laensstyrelsen, Ostersund (Sweden).
For primary bibliographic entry see Field 5C.
W85-04490

CONCEPTUAL MODEL OF LAKE ACIDIFICATION,
Norges Landbrukshoegskole, Aas. Dept. of Agricultural Hydrotechnics.
For primary bibliographic entry see Field 5C.
W85-04531

CHANGES IN BASE CATION CONCENTRATIONS DUE TO FRESHWATER ACIDIFICATION,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 5C.
W85-04532

EXPERIMENTAL LAKE FERTILIZATION: TURNOVER OF NITROGEN AND PHOSPHORUS IN STRATIFIED AND NON-STATIFIED SUBARCTIC LAKES IN NORTHERN SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
M. Jansson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 708-711, October, 1984. 2 Tab, 5 Ref.

Descriptors: *Lakes, *Fertilization, *Nitrogen, *Phosphorus, *Sweden, Subarctic lakes, Stratification, Lake sediments, Nutrients, Plankton, Thermoclines, Sorption, Denitrification.

Important features of the whole lake metabolism of N and P are summarized as they became evident from experiments with artificial nutrient addition to subarctic lakes in the Kuokkel area, northern Sweden. The field studies began in 1971 and were terminated in 1980 during which interval N and P were supplied as single nutrients or in combination to two shallow polymictic lakes, Lake Hymenjaure and Lake Magnusjaure, and one deeper thermally stratified lake, Lake Gunillajaure. The differences in the effect and utilization of increased nutrient input to stratified and nonstratified lakes can be satisfactorily explained by the existence or absence of a thermocline and the manner in which the stratification affects the whole lake metabolism of N and P. Furthermore, they emphasize the highly important role of the sediments as active metabolic sites in the turnover of nutrients, particularly in shallow lakes. The fact that the utilization of nutrients in Lake Gunillajaure was nearly twice as high as in the holomictic lakes means that more of the supplied nutrients were available to plankton. This in turn is a consequence of the thermocline which constitutes a very efficient barrier preventing nutrients from having contact with large areas of the sediment-containing sites for P sorption and denitrification. In shallow lakes the organisms in lake water become nutrient-limited because of the efficient P sorption and denitrification in the sediment. With this background the fate of added nutrients in the different types of lakes in the Kuokkel area can be described as follows. When N + P is supplied to shallow fully circulating lakes the sediments more or less continuously sorb parts of the added P. N is not actively locked in the bottoms but instead metabolized in denitrification processes which reduce the amount of N available for production in the water column. In the stratified lake the thermocline prevents the contact between the sediment and the epilimnion and consequently more N and P are metabolized in planktonic production. Excess of N available for denitrification does not occur until mineralization and nitrification have supplied a surplus of NO3, which in the Kuokkel experiments happened after one winter. (Baker-IVI)
W85-04534

VARIATION OF WATER QUALITY PARAMETERS IN MESO- TO HYPEREUTROPHIC LAKES,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
C. Forsberg, and U. Heyman.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 730-733, October, 1984. 2 Fig, 1 Tab, 10 Ref.

Descriptors: *Lakes, *Sweden, *Mesoeutrophic lakes, *Hypereutrophic lakes, *Water quality, Conductivity, Nutrients, Nitrates, Phosphates, Ammonium, Nitrogen, Phosphorus, Chlorophyll a, Nitrites, Seasonal variation.

Taking into consideration that the ecological functions of the separate water quality parameters are similar in most lakes, it is likely that their concentrations are subject to similar principle types of variation. Surface water samples were taken 3-7 times per week, mainly during June to September, from 25 meso- to hypereutrophic Swedish lakes for a total of 950 samples. Samples were mixed to obtain composite weekly samples and analyzed for 13 water quality parameters. The relative range for conductivity was very narrow about 0.3 x mean. Total-P, total-N, transparency and absorbance (suspended solids) had ranges of about 1.3 x mean. The widest range was noted for NO3-N, 6.5 x mean. The relationships between the relative ranges were: conductivity:tot-P:MRP:chlorophyll a:NH4-N:NO3-N = 1:4:6:7:14:19. Variances within lakes varied in the same order as ranges. Comparatively high variance was noted for phosphorus, especially for MRP. The variances between lakes dominated for all variables with exception of NH4-N and NO3-N; between- and within-lake variances were of similar size for the former while the latter showed very pronounced variance within the lakes. Phosphorus showed low within-lake variance in surface water during summer, indicating steady-state. The highest between-lake variances were obtained for phosphorus and NO2-N, probably due to varying loading conditions. Phosphorus can be looked upon as a regional variable while nitrogen can be characterized as a time variable. The degree of bio-activity, including also bacterial processes, will regulate the concentration ranges for certain parameters greatly; because nutrients like NH4-N and NO3-N have low concentration levels but are highly involved in physiological processes, these nutrients are often exhausted during summer. The variances of chlorophyll a were low in relation to those of P and N. This indicates light limited algal growth in these productive waters. (Collier-IVI)
W85-04536

SMALL-SCALE TEMPORAL CHANGES IN THE BIOLOGICAL AND CHEMICAL COMPOSITION OF SURFACE MICROLAYERS IN A EUTROPHIC LAKE,
Lund Univ. (Sweden). Lab. of Ecological Chemistry.
A. Sodergren.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 765-771, October, 1984. 4 Fig, 1 Tab, 12 Ref.

Descriptors: *Surface layers, *Lakes, *Eutrophic lakes, *Micro layers, *Chemical composition, *Lake Havagardsjon, Plankton, Phytoplankton, Zooplankton, Algae, Cyanophyta, Dynophyceae, Organic carbon, Lipids, Chlorophyll.

To study the influence of vertical organism migration on the chemical composition of surface microlayers (SM) of a eutrophic lake, the distribution in SM of organic carbon, lipids, pigments, phytoplankton, and bacteria was examined every fourth hour during one day and compared to the subsurface water (SS). SM was sampled with a rotating drum mounted on a 1.5 m catamaran; the drum was coated with a layer of hydrophilic teflon and water adsorbed onto the teflon was scraped off with a hydrophobic teflon blade and collected into a bottle. One l of microlayer water was normally collected within 1 h. Samples were collected in September 1981 on natural slicks present on Lake Havgardsjon which were characterized by the absence of capillary waves and defined by surface tension measurements. The thickness of the layer sampled was 10-40 micro m. Compared to the subsurface water an enrichment in the microlayer was evident for dissolved lipids, particulate organic carbon, dissolved organic carbon, chlorophyll a, phytoplankton and bacteria. A distinct diel pattern was also noted and a vertical phototactic migration was found for Cyanophyta and Dinophyceae. The phytoplankton community of the surface microlayer showed a species-abundance distribution which was significantly different from that of the subsurface community. The differential distribution is probably a function of resource partioning between SM and SS, transport mechanisms, and the microlayers' physical and chemical properties to keep the organisms attached to the air/water interface. (Collier-IVI)
W85-04538

DISSOLVED ORGANIC CARBON IN DANISH LAKES: CONCENTRATION, COMPOSITION, AND LABILITY,
Aarhus Univ. (Denmark). Botanical Inst.
For primary bibliographic entry see Field 5C.
W85-04540

DECLINE OF ZOOBENTHOS THROUGH FIVE DECADES OF EUTROPHICATION IN LAKE ESROM,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 5C.
W85-04541

LIGHT PENETRATION AND SOME RELATED CHARACTERISTICS IN SMALL FOREST LAKES IN SOUTHERN FINLAND,
Loughborough Univ. of Technology (England). Dept. of Human Sciences.
R. I. Jones, and L. Arvola.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 811-816, October, 1984. 4 Fig, 2 Tab, 14 Ref.

Descriptors: *Finland, *Lakes, *Light penetration, *Water color, Chlorophyll a, Zooplankton, Phytoplankton, Euphotic zone, Organic carbon, Turbulence.

Water color is a conservative parameter which is easily measured and is consequently of great value if water color can be used to predict light extinction and euphotic zone depth, variables which occur in several limnological models. A survey was conducted of 14 small forest lakes in the Evo district of Southern Finland which were selected to give the widest possible range in water color (5-335 mg Pt/l). Penetration of total photosynthetically active radiation (PAR) was measured during early August at the time of most intense stratification of the water columns. The extinction coefficient for total PAR (ePAR), and hence the depth of the euphotic zone, was strongly correlated with water color, which provided a better prediction of ePAR than either dissolved organic carbon or absorbance at 260 nm. Chlorophyll alpha concentration in the lakes had no significant influence on ePAR. The depth of the mixed layer showed a strong inverse relationship to water color so that the effective light climate experienced by phytoplankton was much less variable between lakes than might be expected from the variability of water color and ePAr. Most of the lakes contained a very high proportion of motile or buoyant forms in their phytoplankton, but there was no evidence for any trend of increasing representation of flagellated phytoplankton with increasing water color. In these small lakes the lack of turbulence is probably of more importance in promoting the development of populations of motile phytoplankton. (Collier-IVI)
W85-04542

PHYTOPLANKTON IN 151 EASTERN FINNISH LAKES: SPECIES COMPOSITION AND ITS RELATIONS TO THE WATER CHEMISTRY,
Helsinki Univ. (Finland). Dept. of Botany.
K. Ilmavirta, P. Huttunen, and J. Merilainen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 822-828, October, 1984. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Lakes, *Finland, *Phytoplankton, *Species composition, Chemical properties, Stratification, Oligotrophic lakes, Eutrophic lakes, Mesotrophic lakes, Humic lakes, Algae.

An extensive study of 151 lakes in Eastern Finland was started in 1978. The aim of this work was to study the chemical status of lake water and the properties of the catchment area and relate their physicochemistry to the community structure of the present phytoplankton and to the recent assemblages of organisms in the sediment, all parameters being measured in every lake within as short a time period as possible. Phytoplankton during the summer stratification in 1980 are described. The lakes are grouped according to their water chemistry into eight classes and their characteristics are discussed in comparison with phytoplankton. The phytoplankton species composition is presented from each group for one characteristic lake. Flagellates are the most important contributors to biomass and had highest species numbers in the darkest and most oligotrophic lakes. Eutrophic lakes are characterized by Chlorophyceae, Cyanophyceae and also by Diatomophyceae. Flagellates occurred in all types of lakes, the Cryptophyceae species being more characteristic for oligotrophic than mesotrophic waters. The cell number of Chrysophyceae is more variable than that of Cryptophyceae. It is remarkable that these flagellated species are almost the only ones able to grow in the acidic lakes. The broad ecological amplitude of flagellates is one of the most important characteristics of phytoplankton in humic lakes and it seems to have fundamental effects on the production ecology and the structure of humic lake ecosystems. (Baker-IVI)
W85-04543

LOOSDRECHT LAKES RESTORATION PROJECT, AN INTRODUCTION,
Limnologisch Inst., Nieuwersluis (Netherlands).
L. van Liere, S. Parma, L. R. Mur, P. Leentvaar, and G. B. Engelen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 829-834, October, 1984. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Lake restoration, *Netherlands, *Loosdrecht Lakes, Eutrophication, Peat, Water management, Planning, Water resources development, Polders, Phytoplankton.

The shallow Loosdrecht Lakes are located 20 km south-east of Amsterdam. The lakes are partly man-made, and situated in a strip of lowlying peatlands between the Holocene coastal sand dunes to the west and the Pleistocene ice-pushed ridge of Het Gooi. The total catchment area of the lake system consists of 44.4 sq km. The reclamation of deep lying polders in the south and the west induced an extension of the groundwater flow system to deep polder outlets to the south and west. The largest part of the upward migrating groundwater in the eastern part of the catchment area is presently extracted and used for drinking water supply. In the north-western part of the lake system a storage basin was constructed that is fed with water from Polder Bethune. This, together with initially untreated sewage from expanding surrounding inhabited areas and an explosion of water-based recreation, resulted in drastic limnological changes. Phytoplankton biomass increased substantially by the highland protracted phosphorus load, and light irradiance attentuation brought about by this increase led to a disappearance of a large part of the submerse macrophytes and characeans. Diversity of phytoplankton diminished. The zooplankton community structure and grazing indicate increasing trophy. The top layer of the lake sediments now consists of dy, which is gyttja mixed with humic substances from the remnants of the eroded banks. During the next years the waterworks expects to increase their supply capacity, implying a higher demand for water from Polder Bethune. Careful monitoring of the project will be undertaken as there is a decided difference of opin-

ion on how best to achieve this increase in capacity. (Baker-IVI)
W85-04544

LOOSDRECHT LAKES RESTORATION PROJECT: HYDROLOGY AND PHYSICO-CHEMICAL CHARACTERISTICS OF THE LAKES,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
B. F. M. Kal, G. B. Engelen, and T. E. Cappenberg.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 835-841, October, 1984. 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Lake restoration, *Netherlands, *Loosdrecht lakes, Hydrology, Physicochemical properties, Hydrology, Eutrophication, Groundwater.

The Loosdrecht Lakes area consists of a series of lakes, which have become eutrophic over the past decades. To restore them, changes in water management are planned. The main compartments or subsystems of the lake system include central open lake, peripheral open lakes, and bank and cut areas. All lakes in the system are too shallow for thermal stratification. Horizontal mixing is usually strong enough to keep concentration nearly uniform within each subsystem, with the exception of Kievitsbuurt. Each of the subsystems has its own hydrological regime and water quality. Accurate water and nutrient balances of the whole system or any subsystem require a separate evaluation of gains from and losses to groundwater. A groundwater flow model of the entire catchment area is being constructed. The input of polluted Vechtwater does not adequately explain the present patterns of nutrient concentrations and of trophic state. It remains to be investigated if the intended elimination of Vecht-water intake is sufficient for complete restoration. Additional measures should be studied on the basis of a better understanding of the hydrological regime and the water quality patterns in surface and groundwater. To gain that understanding, separate balances of water, chloride, and nutrients for every subsystem on a monthly basis are needed. (Baker-IVI)
W85-04545

SESTON-EPIPELON INTERRELATIONSHIPS IN THE SHALLOW EUTROPHIC LOOSDRECHT LAKES (THE NETHERLANDS),
Limnologisch Inst., Nieuwersluis (Netherlands).
J. C. Kromkamp, and H. J. Gons.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 853-857, October, 1984. 4 Fig, 1 Tab, 9 Ref.

Descriptors: *Seston, *Epipelon, *Loosdrecht Lakes, *Netherlands, *Nutrients, Carbon, Nitrogen, Aquatic drift, Eutrophic lakes, Resuspension.

Samples were collected along a stretch of sandy bottom at 0.5, 1.0, and 1.5 m depth in the central part of the lake. The differences in chemical composition between epipelon and seston were small. Probably there is an intensive exchange between the two compartments. The C/N ratio of the seston is, however, significantly lower during the summer than the C/N-ratio. The differences must be even larger if epipelon samples are corrected for the presence of seston. If the exchange between the two compartments is intensive, only slight difference in the C/N-ratio's are expected. Since the differences were larger, resuspension of the epipelon does not seem to have occurred. Calculations predict a considerable increase in the C/N-ratio of the seston if full resuspension were to occur. Alternatively, the epipelon may be resuspended but could quickly resettle: indeed a fraction of the epipelon sedimented rapidly. It seems likely that resuspension of epipelon was not important during the summer months. (Baker-IVI)
W85-04547

ZOOPLANKTON AND ITS GRAZING AS MEASURES OF TROPHY IN THE LOOSDRECHT LAKES,
Limnologisch Inst., Nieuwersluis (Netherlands).
R. D. Gulati.
Verhandlung Internationale Vereingung Limnologie, Vol. 22, p 863-867, October, 1984. 3 Fig, 2 Tab, 11 Ref.

Descriptors: *Zooplankton, *Grazing, *Netherlands, *Loosdrecht Lakes, Lakes, Population dynamics, Species diversity, Trophic level, Crustaceans, Rotifers, Biomass.

The study was carried out in the main Loosdrecht Lakes and at Lake Breukeleveen. Of the ten species of crustaceans and nineteen species of rotifers recorded in 1981 through 1982, some have persisted in low densities since 1955. A ten-fold rise in the rotifer numbers since 1955 is striking and involves both increased densities of Keratella cochlearis and Polyarthra sp., and the appearance of new species, viz. Anuraeopsis fissa and Pompholxy sulcata. The total zooplankton biomass has increased about 6 times. Important in relation to the zooplankton grazing activity is the high food concentration, dominated by filamentous blue-greens, paticularly in Lake Breukeleveen. The grazers are predominantly small-sized crustaceans, Bosmina spp., and Chydorus sphaericus, and rotifers. The average grazing rates of between 13 and 22%/d in the Loosdrecht Lakes and 24% in Lake Breukeleveen are quite comparable with those in the mesotrophic Lake Vechten and also in the eutrophic Lake Tjeukemeer. (Baker-IVI)
W85-04548

SIZE CLASSES OF 'DISSOLVED' NUTRIENTS IN SHALLOW, ALKALINE, HUMIC AND EUTROPHIC TJEUKEMEER, THE NETHERLANDS, AS FRACTIONATED BY ULTRAFILTRATION,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
For primary bibliographic entry see Field 2K.
W85-04550

MODELLING EUTROPHICATION IN SHALLOW DUTCH LAKES,
Waterloopkundig Lab. te Delft (Netherlands).
For primary bibliographic entry see Field 5C.
W85-04551

DISTRIBUTION, DYNAMIC AND STRUCTURE OF FREE DISSOLVED CARBOHYDRATES IN THE PLUSSSEE, A NORTH GERMAN EUTROPHIC LAKE,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
U. Munster.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 929-935, October, 1984. 7 Fig, 1 Tab, 21 Ref.

Descriptors: *Eutrophic lakes, *Carbohydrates, *Plusssee, *Germany (Federal Republic), Phytoplankton, Nutrients, Disaccharides, Monosaccharides, Dissolved solids, Diatoms, Bacteria, Plankton.

Water from the Plusssee was collected every 4 hours from 0.2, 1, 2, 3, 4, and 5 m depths. The distribution pattern of the total free dissolved carbohydrate fraction (TCHO), disaccharides fraction (DCHO) and monosaccharides fraction (MCHO) in the 0.2 m water layer followed generally the light depending photosynthesis and dark depending respiration periods. But in the deeper water layers (1-5 m), some deviations in distribution and dynamic were observed. These deviations could be responsible for the different adaptations and compositions of the microbial communities at the corresponding depths. The high concentrations and variations of the DCHO fraction at the 1 and 4 m depths were due to the contributions of cellobiose and sucrose at 1 m and cellobiose and melibiose at 4 m. The dynamics of the carbohydrate fraction appear to be related to the activity of the phytoplankton and bacterial communities. The plankton population was dominated by diatoms and to a lesser extent by flagellates. The diatom population showed a strong shift from 4 cell colonies to 2 cell colonies, especially at the 2 to 4 m depths. At the same time, a rapid depletion of dissolved silica from 150 micro-g Si/liter to 50 micro-g Si/liter was noted. On April 1 at 6 am, the TCHO, DCHO, MCHO and some individual carbohydrates like cellobiose, sucrose, glucose, and galactose showed the highest variation in 3 and 4 m depths. The carbohydrate composition at this depth may be influenced by a break-down of diatoms and discharge of their storage products and cell wall material into the water. In the dissolved organic carbon, carbohydrates and proteins are always accompanied by humic substances with different molecular weights and strong pH-dependent surface activities. (Baker-IVI)
W85-04552

METHANOGENESIS IN SEDIMENTS OF EUTROPHIC LAKES; 2. COMPARATIVE INVESTIGATIONS ON THE METHANE-PRECURSOR PREFERENCE,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
M. Naguib.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 951-955, October, 1984. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Methane, *Lake sediments, *Eutrophic lakes, *Kleiner Ukleisee, *Plon, *Germany (Federal Republic), Lakes, Chemical reactions, Acetate, Ammonium chloride, Peptone.

Sediment methanogenesis was estimated for surface sediment samples collected from the 'Kleiner Ukleisee,' a 20,000 sq m eutrophic forest lake in Plon, Germany (Federal Republic). Methane production was at maximum in the presence of methanol as a methane precursor compared to acetate and H2/CO2. Maximum production from methanol was in the range of 12 micro moles CH4/g wet wt. of sediments compared to 0.5 and 0.4 micro moles from acetate and H2/CO2. Further increases up to 17 and 32 micro moles were reached in the presence of ammonium chloride and peptone, respectively, corresponding to a methanol conversion efficiency of 35 and 63%. With acetate, only peptone caused a relative increase to 1.8 micro moles amounting to 35% conversion efficiency. Methanol was dominant among the methane precursors used and the combination of methanol and peptone gave maximal methane production. As a forest lake, the lake would receive allochthonous substances rich in substrates for methanol genesis. (Collier-IVI)
W85-04554

IMPACT OF SEDIMENTATION ON THE PHOSPHORUS CONTENT OF THE EUPHOTIC ZONE OF LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
H.-H. Stabel.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 964-969, October, 1984. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Phosphorus, *Sedimentation, *Lake Constance, *Euphotic zone, Particulate matter, Organic matter, Cycling nutrients, Mesotrophic lakes, Fate of pollutants.

Lake Constance is a large, deep, and mesotrophic pre-alpine lake, heavily fertilized in the last three decades. Water samples were taken weekly from 20 depths between 0 and 140 m from the Uberlinger See, which is a deep (147 m) northwestern bight of Lake Constance. The data obtained indicate that in Lake Constance phosphorus is mainly precipitated as a constituent of particulate organic matter. The increase in the sedimentation rates of P in 1981 coupled with the nearly unchanged content of total phosphorus in the water basin accounted for the enhanced loading. The P masses entering the lake comprise soluble reactive phosphorus (SRP) as well as unreactive mineral particulate phosphorus. While the latter is precipitated directly, the bulk of SRP is transferred into biomass, followed by a rapid cycling within the euphotic zone, and finally is deposited. Thus a surplus load of SRP over the past vegetational period is re-

duced and a metastable equilibrium concentration of SRP is maintained even though the input of phosphorus has varied widely. (Baker-IVI)
W85-04555

EXTERNAL AND INTERNAL LOADING AND RETENTION OF PHOSPHORUS IN THE R. JORKA LAKES (MASURIAN LAKELAND, POLAND) VS THEIR TROPHIC STATUS,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
A. Hillbricht-Ilkowska, W. Lawacz, and R. Wisniewski.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 973-977, October, 1984. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Phosphorus, *Lakes, *Lake sediments, *Poland, Lake Glebokie, Lake Majcz, Lake Jorzec, Lake Inulec, Great Masurian Lakes, Phytoplankton production, Lake sediments, Seasonal variation.

The annual input of phosphorus from external (point and non-point) and internal (released from bottom sediment) sources is compared with its retention and the change of P stock in waters of the lakes different in respect to watershed conditions, human impact, morphology, productivity and chemical nature of bottom sediments. The lakes under study are connected by the River Jorka, which enters one of the Great Masurian Lakes. The phytoplankton production is lowest in the stratified Lake Majcz located in the upper, forested part of the watershed. The results demonstrate the relative significance of internal and external loading in controlling the trophic status of a lake. The shallow and productive Lake Inulec is controlled by internal loading. The ratio release to sorption rate of P for the sediments is as high as 25:1 and the net sedimentation rate is quite low. Due to the great flushing rate (mainly in the spring) Lake Jorzec seems to be mostly controlled by internal loading during summer when sediments rich in Al and Fe release the available P; in other seasons they intensively sorb it. The R:S ratio is practically 1:1 and the assessed net sedimentation rate is quite close to the measured internal loading value. In Lake Majcz the release of P from sediments rich in Ca is ten times higher than the external load, but is practically limited to two months, and is balanced by sedimentation in other seasons. The same can be said about Lake Glebokie in which the high external loading is coupled with the heavy internal loading, with the latter limited to the second half of the year. Therefore the highest sedimentation rate is probably still effectively counteracting the increase of P in the lake water. (Baker-IVI).
W85-04556

OUTDOOR RECREATION - A NEW FACTOR DISTURBING LAKE ECOSYSTEMS, AS EXEMPLIFIED BY LAKE GIM, MAZURIAN LAKE DISTRICT,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
For primary bibliographic entry see Field 5C.
W85-04557

ROLE OF BIVALVES IN THE PHOSPHORUS AND NITROGEN BUDGET IN LAKES,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
A. Stanczkowska.
Verhandlung Internationale Vereinigun Limnologie, Vol. 22, p 982-985, October, 1984. 5 Tab. 8 Ref.

Descriptors: *Mussels, *Littoral zones, *Lakes, Phosphorus, Nitrogen, Cycling nutrients, Biomass, Eutrophication, Trophic level.

Dreissena polymorpha is one of the most numerous mussels in the littoral of lakes, and certainly the most important one regarding the biomass. Meso- and eutrophic lakes of Masurian Lakeland were used to determine whether mussels occurring in lakes in such great numbers as D. polymorpha may be of importance in counteracting the process of eutrophication. P and N contents of D. polymorpha bodies ranged from 0.85% to 0.93% and from 11% to 12.8%, respectively. The highest percentage of P in the mussels was noticed in the prereproductive period. The percentage of P and N in the body changed with the age of mussels, with the highest values in the youngest individuals. The quantities of P accumulated in mussel populations in a mesotrophic lake are similar to loading of P measured in the lake, but in a highly eutrophic lake, they are about 50 times smaller than the annual loading. The P and N accumulated in mussels is removed from cycling in the lake for a period of a few years (the lifetime of a mussel is estimated at 4-6 years, and about 20 years for shell decomposition). In lakes where D. polymorpha occurs in great density and occupies considerable surface on the lake bottom, its role in P and N cycling within lakes should not be neglected. This mussel was significantly more dominant in dimictic and less eutrophic polymictic lakes than in the rest of investigated lakes. The data suggest that the role of D. polymorpha in P and in cycling is important in meso- and moderately eutrophic lakes, but it is not significant in highly eutrophic or hypertrophic lakes. (Baker-IVI)
W85-04558

EFFECTS OF INTERNAL MEASURES IN BALDEGGERSEE: FORCED-CIRCULATION AND OXYGENATION OF THE HYPOLIMNION (DIE AUSWIRKUNGEN VON INTERNEN MASSNAHMEN IM BALDEGGERSEE: ZWANGSZIRRKULATION UND SAUERSTOFFBEGASUNG DES HYPOLIMNIONS),
Luzern Kantolales Amt fuer Gewasserschultz (Switzerland).
For primary bibliographic entry see Field 5G.
W85-04559

STREAM PHOSPHORUS EXPORTS FROM PREALPINE WATERSHEDS WITH RESPECT TO GEOLOGY AND LAND USE,
Osterreichisches Eutrophieprogramm, Projekt Salzkammergutseen, A-4852 Weyregg, Austria.
For primary bibliographic entry see Field 5B.
W85-04560

PHYTOPLANKTON AS BIOLOGICAL PARAMETER FOR THE TROPHIC CHARACTERIZATION OF LAKES,
Innsbruck Univ. (Austria). Botanisches Inst.
E. Rott.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1078-1085, October, 1984. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Trophic level, *Lakes, *Phytoplankton, Bioindicators, Water pollution effects, Eutrophication, Species composition, Succession, Biovolume.

An examination is made of how far structure and dynamics of phytoplankton assemblages and total biovolumes found in 40 Tyrolean lakes during 8 years of monitoring reflect their trophic conditions. The lakes investigated are situated in low mountain regions of Tyrol (Austria) and are mainly used for recreation such as swimming and rowing. In many cases a rapid stratification after ice-out and relatively low wind incidence and flushing, allows development of high maximum surface temperatures. The study suggests that qualitative phytoplankton investigations give valuable information on species composition and succession of phytoplankton assemblages; phytoplankton assemblages follow some general patterns which are determined in quality and quantity by the trophic status; phytoplankton biovolume is at least as valuable a component of lake eutrophication studies as chlorophyll-a; and in the light of general relationships phytoplankton constitutes a rather sensitive measure for clarifying the specific trends of development for each particular lake. (Baker-IVI)
W85-04561

EUTROPHICATION OF LAKE BALATON: MEASUREMENTS, MODELING AND MANAGEMENT,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
For primary bibliographic entry see Field 5C.
W85-04562

AVAILABILITY OF SEDIMENT P IN LAKE LUGANO,
Commission of the European Communities, Ispra (Italy).
G. Premazzi, and G. Zanon.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1113-1118, October, 1984. 3 Tab, 20 Ref.

Descriptors: *Lake sediments, *Phosphorus, *Algae, *Lake Lugano, Bottom sediments, Algal growth, Phosphate, Apatite, Available phosphorus.

The release of P available to algae associated with bottom sediments was quantified in Lake Lugano. The P available chemically by extraction techniques was characterized and the amount of P available was compared with that estimated from mass balance calculation. It was felt that in Lake Lugano, where a program of recovery from eutrophication was initiated in 1976, the effects of P reduction might be delayed by the release of phosphorus from sediments. The phosphate adsorbed onto bottom sediments can be important in the overall P budget of this basin of Lake Lugano. On the average, 12% of total P was available for algal growth. The nonapatite inorganic fraction contributed to the largest proportion (42-100%) of P immobilized by Selenastrum, with the except of summer sediments when a significant proportion (35%) of organic P was assimilated by algae. Some availability of apatite P was also noticed. Because of the great variations with season and water-column depth of the sediment P content, no correlations between the available P and the different forms of sediment P were found. Inorganic phosphate content of the sediment cannot be used to predict the potentially available P of sediments. It is important to developing strategies to determine available P rather than total P. (Baker-IVI)
W85-04563

IMPORTANCE OF MACROPHYTES IN TWO LAKES WITH DIFFERENT TROPHIC DEGREE: LAKE COMABBIO AND LAKE MONATE (PROVINCE OF VARESE, NORTHERN ITALY),
Commission of the European Communities, Ispra (Italy).
O. Ravera, C. Garavaglia, and M. Stella.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1119-1130, October, 1984. 6 Fig, 3 Tab, 31 Ref.

Descriptors: *Macrophytes, *Trophic levels, *Lake Monate, *Lake Comabbio, *Italy, Aquatic plants, Nutrients, Turbidity, Water pollution effects, Phosphorus, Eutrophication.

Because the role played by the macrophytes in the ecosystem varies according to the charateristics of the ecosystem, research was carried out on the vegetation of two small lakes laying in the same area but having different characteristics. A series of stations (12 for Lake Comabbio and 18 for Lake Monate) were chosen along the entire littoral zone from which macrophyte samples were collected. Lake Comabbio is very rich in species, if compared with Lake Monate, but in the latter there are 8 submerged species, whereas in Lake Comabbio there are only 4. In Lake Comabbio emergent species form the greatest part of the macrophyte biomass, whereas in Lake Monate the submerged have a biomass similar to that of the reeds. The most probable cause of this difference is the higher water turbidity in Lake Comabbio compared to Lake Monate. In the last decades the turbidity of Lake Comabbio has increased following an increase in municipal pollution. If the total amount of P immobilized in the macrophytes were released and homogeneously distributed in the lake water the total P concentration should increase by 10.9 mg/cu m in Lake Comabbio and by 0.5 mg/cu m in Lake Monate. If these values are related to unit

surface one would obtain 50 mg TP/sq m of lake surface for Lake Comabbio and 10 mg TP/sq m for Lake Monate. Because macrophytes are part of the lake ecosystem, the amount of P they release does not represent a true load to the lake. Larger quantities of nutrients discharged to Lake Comabbio support a greater biomass of macrophytes than in Lake Monate, which receives only one sixth of the P loading of Lake Comabbio. (Baker-IVI)
W85-04564

IMPACT OF NUTRIENT LOAD ON TOTAL BIOMASS AND SPECIES SUCCESSION IN LAKE SUWA, JAPAN,
MAXIMUS, Inc., McLean, VA.
For primary bibliographic entry see Field 5C.
W85-04565

RECENT CHANGES IN THE ECOLOGY OF LAKE NAIVASHA, KENYA,
Leicester Univ. (England). Dept. of Adult Education.
D. Harper.
Verhandlung Internationale Vereinigung Limnology, Vol. 22, p 1193-1197, October, 1984. 7 Ref.

Descriptors: *Lake Naivasha, *Kenya, *Ecology, Phytoplankton, Zooplankton, Nutrients, Invertebrates, Macrophytes, Fish, Birds, Water level fluctuations, Introduced species, Aquatic habitats.

Studies were carried out on aspects of the phytoplankton, zooplankton, benthic invertebrates, subaquatic macrophytes, fish and aquatic birds of Lake Naivasha, Kenya's second largest freshwater lake. Important for its commercial fishery, use for irrigation, aquatic bird populations and tourist value, the lake ecosystem is affected by extensive natural water level fluctuations. In addition to natural changes, several accidental or deliberate species introductions have altered the ecosystem in various ways in recent decades. During the period of study the northern and western half of the lake's surface and particularly the western quarter were covered by extensive rafts of papyrus and Salvinia molesta, which moved freely under the wind and currents. Changes observed during this short period of study include the loss of sub-aquatic macrophytes, the increase of Salvinia, the changes in diversity of littoral and benthic invertebrates and the stability of the phytoplankton and the zooplankton. (Baker-IVI)
W85-04566

DIURNAL CYCLE OF STRATIFICATION IN LAKE TITICACA: EDDY DIFFUSION,
California Univ., Davis. Div. of Environmental Studies.
T. Powell, M. H. Kirkish, P. J. Neale, and P. J. Richerson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1237-1243, October, 1984. 2 Fig, 2 Tab, 38 Ref.

Descriptors: *Lake Titicaca, *Diurnal variation, *Eddy diffusion, *Stratification, Diffusion, Thermoclines, Mixing, Model studies, Epilimnion.

The evolution of diurnal thermal structure was analyzed as a one dimensional (vertical) diffusion processes and the extent to which this simple formulation is capable of explaining the details of the diurnal variation in Lake Titicaca was examined. Beyond simplicity, this approach has the advantage that the detailed data sets needed for the well-mixed layer model studies are not necessary. Moreover, unlike the detailed mixed layer models, the results may be readily applied to biological studies for which some knowledge of surface layer stratification may be critical. Results are explained for approximate (bulk) diffusivity estimates, and depth-dependent vertical diffusion. Despite drawbacks, the eddy diffusion phenomenology provides a simple initial description of processes occurring in the epilimnion. The calculations are useful first estimates of the spatial and temporal scales of these processes. Eddy diffusion calculations have ready applications in ecological studies. (Baker-IVI)
W85-04567

AMAZON FLOODPLAIN LAKES: SHAPE, FETCH, AND STRATIFICATION,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1278-1282, October, 1984. 3 Fig, 1 Tab, 11 Ref. NSF grants DEB78-23642 and DEB81-11398.

Descriptors: *Lake morphology, *Fetch, *Stratification, *Amazon floodplain, *Brazil, Wind, Mixing, Radar, Lakes.

The shape and maximum fetch of all lakes greater than 100 m across in the floodplain of the Rio Solimoes-Amazonas were determined from photographs made from side-scanning radar images. Shapes were divided into six categories: round to oval, dendritic, oxbow, crescent, levee, and composite. Both the number of lakes and the proportion of each shape vary in different regions of the floodplain. Most Amazon floodplain lakes have fetches of between 250 and 1000 m. About 10% are less than 250 m across but are still recognizable on the radar photographs. One likely consequence of the range in fetches is differences in the effectiveness of wind mixing and vertical stratification. A test of the hypothesis that vertical mixing in Amazon floodplain lakes is primarily a function of exposure to wind and that an increase in stratification should occur as fetch is reduced is in progress. (Baker-IVI)
W85-04568

VERTICAL MIXING IN AMAZON FLOODPLAIN LAKES,
California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
S. MacIntyre, and J. M. Melack.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1283-1287, October, 1984. 4 Fig, 2 Ref. NSF grants BED78-23642 and DEB81-11398.

Descriptors: *Mixing, *Lakes, *Amazon floodplain, *Lake Calado, *Brazil, Destratification, Temperature effects, Seasonal variation, Wind, Convection, Solar radiation.

The Amazon floodplain lakes lie in the humid lowlands of equatorial South America and rise and fall in level in concert with the annual river flood. Coincident with the changes in depth are variations in the frequency of vertical mixing. Vertical mixing was studied in Lake Calado, which is narrow and dendritic with a region enlarged by a lateral levee. During the period of low but rising water, the lake is turbid and only 3 m deep. Temperatures at the surface increased by as much as 2.5 C during the day, but each day the lake became isothermal by early morning. Mixing within the lake can occur during the day if wind speeds are sufficient to overcome buoyancy forces established by the stable density gradient. Mixing can occur at night as a result of forced convection by wind or free convection due to an unstable density gradient. Daytime mixing is more likely when incident radiation is low. When wind speeds are low, heat derived from the incoming radiation is largely distributed in the upper 2 m. Observations in January of 1981 and February 1983 suggest that once the lake is deeper than about 4 m, mixing to the bottom will only occur when incoming solar radiation is low. At night the region of isothermy or unstable temperature gradient usually extends to a depth of 2 to 2.5 m, although early in the restratification period it extended to the bottom. Because heat loss at night is not just confined to a shallow region at the surface, it appears that free convection augmented by forced convection occurs. These responses of the lake to incoming radiation, wind stress, and cooling illustrate how sensitive the lake is to its recent history. (Baker-IVI)
W85-04569

SEASONAL VARIATION OF THE MAJOR CATION CONTENT OF THE VARZEA-LAKE LAGO CAMALEAO, MIDDLE AMAZON, BRAZIL, IN 1981 AND 1982,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
K. Furch.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1288-1293, October, 1984. 3 Fig, 17 Ref.

Descriptors: *Seasonal variation, *Varzea lakes, *Lago Camaleao, *Brazil, *Cations, Chemical properties, Macrophytes, Aquatic plants, Rivers, Water level.

Seasonal variation in water chemistry was studied in Lago Camaleao, a varzea-lake on an island in the Amazon. Changes in cation content of the river were small and showed no seasonality, but there were large seasonal fluctuations in the cation content of the lake water. More than 15-fold differences between lake and river water were noted in the course of one year. Growth and decomposition of macrophytes occur simultaneously, but in different intensities during the year. In 1981 differences in the amount of major cations in the lake water between January and June were small, indicating that a large portion of cations, brought into the lake by inflowing river water and by lake internal processes, is lost to lake internal processes. The lake system acted as an effective element trap during the period of rising water level in 1981. In 1982 differences in the amount of major cations dissolved in the lake water between January and June were large, indicating a comparatively small lake internal loss of the cations gained from inflowing river water and released within the lake system. The field observation that macrophyte development was less in 1982 due to extreme high water of that year is thus directly reflected by the chemistry of the varzea-lake. (Baker-IVI)
W85-04570

NUTRIENT PROCESSING IN AMAZON FLOODPLAIN LAKES,
Washington Univ., Seattle. Inst. for Environmental Studies.
For primary bibliographic entry see Field 2K.
W85-04571

SENSITIVITY ANALYSIS OF RESERVOIR OXYGEN MODEL,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
W. J. Snodgrass, and M. F. Holloran.
Canadian Water Resources Journal, Vol. 8, No. 3, p 1-25, 1983. 5 Fig, 1 Tab, 44 Ref.

Descriptors: *Dissolved oxygen, *Reservoirs, *Sensitivity analysis, *Model studies, Reservoir sediments, Biochemical oxygen demand, Wind, Solar radiation, Water temperature.

A sensitivity analysis of a dissolved oxygen model currently being applied to several Canadian reservoirs is presented. The model's predictions for temperature show good agreement with observations on a reservoir whose vertical mixing is controlled by inflow-outflow differences, summer stratification and autumnal overturn. Of several hydraulic, meteorological and biochemical variables investigated, model predictions of hypolimnetic oxygen are most sensitive to sediment oxygen demand (SOD). The model is sensitive to land-based inputs of BOD, solar radiation and wind speed, but relatively insensitive to the temperature of inflowing water or the depth of bottom withdrawal. These results suggest criteria for engineering design and siting reservoirs and for priorities for experimental and field measurements of model parameters. For calibration studies, this sensitivity analysis suggests that much attention should be given to the measurement of SOD, and the next priority should be the measurement of the input rate of BOD. At approximately the same degree of importance are measurements of solar radiation, wind velocity and inflow temperature. (Moore-IVI)
W85-04585

ASSESSMENT OF HISTORICAL CHANGE IN TWO NORTHERN MINNESOTA LAKES,
Minnesota Univ.-Duluth. Dept. of Biology.
For primary bibliographic entry see Field 5B.

W85-04602

PHOSPHORUS IN THE BOTTOM SEDIMENTS OF SOME LAKES OF THE WORLD,
Akademia Rolnicza, Wroclaw (Poland). Dept. of Limnology.
J. Golachowska.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 3, p 175-205, 1984. 6 Fig, 13 Tab, 76 Ref.

Descriptors: *Bottom sediments, *Lake sediments, *Phosphorus compounds, Organic compounds, Nitrogen, Organic matter, Iron, Calcium, Aluminum, Sorption, Anaerobic conditions, Mineralization.

Samples of bottom sediments for examination were collected over the period from 1969 to 1975, from 27 lakes in various regions of the world. Concentrations of total phosphorus in the sediments ranged from 2.80 to 12.50 mg PO4/g and were independent to a great extent of the lake trophic type and climatic conditions. High concentrations of phosphorus and nitrogen are usually found in lakes with considerable amounts of organic matter. The total mineral phosphorus content ranged from 1.30 to 9.90 mg PO4/g of sediment; organic phosphorus content ranged from 1.10 to 4.60 mg PO4/g of sediment. The percent of mineral-P in total-P ranged from 25.8 to 84.9%. Mineral-P occurred in bottom sediment bound mainly with iron, calcium and aluminium. Organic-P was represented by phosphoproteins, and to a lesser extent by nucleic acid-P and by very small amounts of phospholipids. The presence of iron, aluminium and organic matter in bottom sediments affected the volume and rate of phosphorus sorption. A given sediment always bound the same amount of added phosphorus, in the same chemical compounds. The binding by certain sediments was a violent process. In tests, the release of phosphorus from bottom sediments (mainly from mineral compounds) was started by microorganisms and followed by physico-chemical and biological processes under oxygen-free conditions. Organic phosphorus compounds under laboratory conditions were highly resistant to mineralization. (Moore-IVI)
W85-04612

PROTOZOAN COLONIZATION RATES AND TROPHIC STATUS OF SOME FRESHWATER WETLAND LAKES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
M. S. Henebry, and J. Cairns, Jr.
Journal of Protozoology, Vol. 31, No. 3, p 456-467, August, 1984. 3 Fig, 9 Tab, 56 Ref.

Descriptors: *Wetlands, *Lakes, *Trophic levels, *Protozoa, *Michigan, Bogs, Eutrophication, Primary productivity, Chlorophyll, Phosphorus, Nitrogen, Nutrients, Trophic level, Artificial substrates.

The colonization dynamics of protozoan communities have been investigated in a variety of lentic and lotic habitats using polyurethane foam (PF) unit artificial substrates. Primary productivity, chlorophyll a, phosphorus and nitrogen nutrients, and other chemical and physical parameters were measured in 13 wetlands in northern lower Michigan. Colonization rates of PF units by protozoa in lakes associated with each of the four major wetland types were compared with water quality of the lakes determined by the other commonly used measures of trophic status. The hypothesis that these common measurements of trophic status would show that wetland lakes, including all bog lakes, were eutrophic was largely confirmed. The waters of all bog and fen sites, with the exception of Hoop Lake Bog, were more eutrophic than moderately eutrophic Douglas Lake and were, in fact, in the generally agreed upon eutrophic ranges for all of the above parameters. Since primary productivity is probably the single most meaningful indicator of the trophic status of a lake and since there was a highly significant positive correlation between primary productivity and colonization rates by protozoa, the hypothesis of a positive correlation between trophic status and colonization rate of PF units by protozoa was also supported. One of the significant results was the confirmation of the usefulness of PF unit artificial substrates both as collecting devices for protozoa and as tools that may give an indication of the trophic status of a body of water. (Baker-IVI)
W85-04657

AQUATIC MACROPHYTE VEGETATION OF AN ISOLATED ISLAND LAKE ADJACENT TO LAKE NIPIGON, ONTARIO: A COMPARATIVE STUDY AFTER A FIFTY-SIX YEAR INTERVAL,
Guelph Univ. (Ontario). Dept. of Botany and Genetics.
H. M. Dale, and C. E. Garton.
Canadian Field Naturalist, Vol. 98, No. 4, p 444-450, October-December, 1984. 1 Fig, 4 Tab, 28 Ref.

Descriptors: *Macrophytes, *Ontario, *Lakes, *Teapot Lake, *Nipigon Lake, *Aquatic weeds, Physicochemical properties, Beavers, Species composition, Vegetation regrowth.

The 1982 appearance of an isolated lake far from human disturbance in North West Ontario, matched the 53-year old report of the distribution and abundance of many aquatic taxa. Readings of the physical and chemical factors were not significantly altered although it was clear that there had been a temporary rise in the water level due to a Beaver dam. The decrease in abundance of Yellow Water Lily (Nuphar variegatum), a narrow-leafed pondweed (Potamogeton friesii), and several marsh plants - Mare's Tail (Hippuris vulgaris), Cowslip (Caltha palustris), Water Arum (Calla palustris), and Marsh Cinquefoil (Potentilla palustris) - was attributed to the raising of the water level. Plants known to be a food for Beavers decreased in abundance, those unpalatable increased. Since 1966, when the lake had returned to normal level, high reproductive capacity favored increased abundance of Stonewort (Chara globularis), Quillwort (Isoetes macrospora and I. echinospora), Northern Watermilfoil (Myriophyllum exalbescens), and Watermarigold (Megalodonta beckii). The opportunistic species on bare aquasoil, Water Starwort (Callitrich sp.) and Pipewort (Eriocaulon septangulare), flourished. The unbroken ring of aquatic vegetation of 1926 had declined in quantity. Differences between the flora of the small isolated lake (Teapot) and that of the large encompassing lake (Nipigon) are due to differences in the temperature of the water, alkalinity and wave action. The lack of suitable invading disseminules may have prevented the establishment in Teapot Lake of Red Pondweed (Potamogeton alpinus), Whitestem Pondweed (Potamogeton praelongus), and Flat-stemmed Pondweed (Potamogeton zosteriformis). The reasons for the absence of Slender Naiad (Najas flexilis) and Horned Pondweed (Zannichellia palustris), present in a bay a few kilometers to the west, remain unclear. (Author's abstract)
W85-04661

SPECIES RICHNESS IN STREAMS OF DIFFERENT SIZE FROM THE SAME DRAINAGE BASIN,
Idaho State Univ., Pocatello. Dept. of Biology.
G. W. Minshal, R. C. Petersen, Jr., and C. F. Nimz.
American Naturalist, Vol. 125, No. 1, p 16-38, January, 1985. 6 Fig, 3 Tab, 73 Ref. NSF grants BMS 75-0733 and DEB 7811671.

Descriptors: *Species diversity, *Invertebrates, *Streams, *Salmon River, *Idaho, Seasonal variation, Drainage basin, Stream order, Immigration.

The species richness of stream benthic invertebrates on rocks in the streams was studied along a longitudinal profile of the Salmon River Basin, Idaho, during spring, summer, and autumn. Replicate rocks were sampled and an analytical approach was used to calculate theoretical number of species present, relative immigration rate, and relative spatial heterogeneity. Species richness varied with stream size, being highest in midorder streams and lower in headwater and high order streams. This downstream shift in species richness conforms to the river continuum concept. Possible cause is associated with varying temperature regimes in the different-sized streams as well as other factors. Species richness also varied with season depending on stream size. Low order streams were more individualistic, probably because of a greater influence of local (terrestrial) environmental conditions, but showed a higher richness in summer than in autumn. Larger streams were more similar and showed a higher richness in autumn than in summer. Other community-level indicators, such as relative immigration rate and extinction rate, also showed seasonal differences. The different macroinvertebrate community types having characteristic of either nonequilibrium or equilibrium conditions can be found in streams from the same drainage basin depending on location along the river continuum and time of the year. These findings have important implications for future studies of stream communities as well as for those of predation and competition in streams. (Baker-IVI)
W85-04665

COMPARISON OF PERIPHYTON GROWTH ON ARTIFICIAL AND NATURAL SUBSTRATES IN THE UPPER SPOKANE RIVER,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
T. S. Nielsen, W. H. Funk, H. L. Gibbons, and R. M. Duffner.
Northwest Science, Vol. 58, No. 4, p 243-248, November, 1984. 2 Fig, 2 Tab, 19 Ref. DOE grant WF 80-002.

Descriptors: *Periphyton, *Substrates, *Spokane River, *Washington, Algal growth, Primary productivity, Bioindicators.

Periphyton are commonly regarded as indicators of water quality; both artificial and natural substrates have been used in studies of periphyton as water quality indicators. Algae selectivity for artificial or natural substrate was studied at 10 sites on the Upper Spokane River in Washington. No definable difference in density was noted between the algae colonizing glass and natural rock substrate. Once the periphyton were attached to the rock substrate, they were able to attain a greater ash-free dry weight and chlorophyll a level than the same density of algae on the glass substrate. Hence, the periphyton on the rock substrate had an advantage over the periphyton on the glass substrate in the process of primary production. It appears that consideration of artificial substrate composed of glass would lead to underestimation of periphyton productivity in flowing waters. (Baker-IVI)
W85-04666

PRELIMINARY INVESTIGATION ON EFFECTS OF FLUCTUATING FLOWS ON INVERTEBRATES OF THE HAWEA RIVER, A LARGE REGULATED RIVER IN NEW ZEALAND,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
J. R. Irvine, and P. R. Henriques.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 3, p 283-290, 1984. 3 Fig, 3 Tab, 10 Ref.

Descriptors: *Invertebrates, *Hawea River, *New Zealand, *Streamflow, *Benthos, Ecological effects, Periphyton, Midges, Caddisflies, Oligochaetes.

An experiment with flow changing at 3, 9, and 18 cu m/s/h on consecutive days failed to produce any measurable effect on benthic invertebrates in the regulated Hawea River, New Zealand, but did result in increased numbers of drifting chironomid larvae, trichopteran larvae, and oligochaetes compared to days when flow was stable. Drift densities were at least as high on the day flow changed at 3 cu m/s/h (minimum flow 15 cu m/s, maximum flow 30 cu m/s) as on subsequent days when flow changed at 9 and 18 cu m/s/h (minimum flows both 15 cu m/s, maximum flows 60 and 105 cu m/s respectively) indicating that rapid rates of change of flow may not necessarily cause more benthic invertebrates to enter the drift than slow rates of change. Fluctuating flows resulted in more animals

entering the drift at a site 5 km below a control dam than at a site 0.8 km below the dam. Drift of non-invertebrate organic matter (mainly periphyton) showed similar patterns to invertebrate drift. Most of the invertebrates displaced by the flow fluctuations were associated with periphyton in the river, and as such, these taxa may have been more prone to being swept away during flow increases than other invertebrate taxa. (Author's abstract)
W85-04668

TRENDS IN LAKE ROTORUA WATER QUALITY,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
J. C. Rutherford.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 3, p 355-365, 1984. 2 Fig, 1 Tab, 22 Ref.

Descriptors: *Lake Rotorua, *New Zealand, *Lakes, *Water quality, Eutrophic lakes, Stratification, Data interpretation, Water pollution effects.

Water quality data for Lake Rotorua, New Zealand, was obtained from three sources and analyzed for trends over the period 1966-1983. The probability density function of each determinand was plotted as a histogram to check visually for serious violations of normality. Those determinands which exhibited markedly skewed distributions were transformed by taking logarithms (base 10). Three periods were separately analyzed for trends - 1967-70, 1971-77, and 1978-83 - because of possible differences in analytical techniques used by the different data collection agencies. After transformation, monthly average values were calculated. A linear regression package was used, but additional manipulations were performed to remove seasonality, fill gaps, and correct for serial correlation. Lake quality deteriorated during 1967-1970 largely because meteorological conditions favored lake stratification. During 1978-1983, despite favorable meteorological conditions, quality again deteriorated at the same time as, and probably as a result of, an increase of available nutrient input from sewage effluent; during this period, oxygen depletion, nutrient, and chlorophyll showed increasing trends - a clear indication of increasing eutrophication. Were sewage nutrient inputs to be reduced to the 1976-77 levels, then a marked improvement in lake water quality would be expected back to the conditions prevailing at that time. (Collier-IVI)
W85-04669

FACTORS AFFECTING CLARITY OF NEW ZEALAND LAKES,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
W. N. Vant, and R. J. Davies-Colley.
New Zealand Journal of Marine and Freshwater Research, Vol. 18, No. 3, p 367-377, 1984. 4 Fig, 3 Tab, 30, Ref, 2 Append.

Descriptors: *New Zealand, *Lakes, *Optical properties, *Irradiance, *Opacity, Turbidity, Scattering coefficient, Color, Transparency, Secchi disks, Suspended solids, Algae, Seston.

Average values of inherent optical properties for the 400-700 nm waveband were estimated from quantum irradiance measurements on 27 New Zealand lakes of diverse optical character, using published nomograms. Secchi disc depths, turbidity, algal pigment, non-volatile suspended solids, and absorption by membrane-filtered samples at 440 nm (g440) were also measured. Turbidity (NTU) correlated closely with the scattering coefficient (per m) and these quantities were almost numerically equal, as found in other studies. The data were found to conform to an expression in the oceanographic literature relating Secchi disc depth to the beam attenuation and diffuse attenuation coefficients. Specific beam attenuation, scattering; and absorption coefficients were estimated from the coefficients of linear multiple regressions of the measured total coefficients on the variables: total pigment (chlorophyll a + phaeopigment), non-volatile suspended solids, and g440. The estimated values were in reasonable agreement with similar specific coefficients reported in the oceanographic literature. The coefficients provide a basis for predicting clarity in new impoundments or for predicting the effects of loading changes (e.g., of nutrients) on the clarity of existing lakes. The coefficients can be used for classifying lake waters into different optical types. (Author's abstract)
W85-04670

STUDIES ON THE CARBON FLUX FROM PHYTO- TO BACTERIOPLANKTON COMMUNITIES IN LAKE CONSTANCE,
Nagoya Univ. (Japan). Water Research Inst.
K. Kato, and H.-H. Stabel.
Archiv fur Hydrobiologie, Vol. 102, No. 2, p 177-192, December, 1984. 4 Fig, 4 Tab, 48 Ref. Deutsche Forschungsgemeinschaft grant AZ: Ti 115/10-2.

Descriptors: *Carbon flux, *Cycling nutrients, *Bacteria, *Plankton, *Lake Constance, *Germany (Federal Republic), Isotope studies, Carbon radioisotopes, Algae, Photosynthesis.

The initial phase of the carbon flux from photosynthetic organisms to heterotrophic bacteria was studied in the eutrophic zone of Lake Constance by use of in situ incubations with labeled $NaHCO_3$ and a differential filtration technique. After the light incubation period (4 or 6 hours) extracellularly released dissolved organic carbon covered 23.2% of the total C-14 that had been photoassimilated, while another 7% was found incorporated into planktonic bacterial biomass. During June (clearwater phase) nearly 60% of the total radioactivity was bound on extracellular material. During the dark incubations ca. 16% of the C-14 was lost from organisms exceeding 3 micro m in diameter. Respiration of algae was supposed to be the main factor affecting these losses. During the first hours from the onset of in situ incubation experiments the accumulation of extracellular organic C-14 always exceeded the rates of consumption by bacteria. Thereafter these two rates were not related. The concentrations of extracellularly released dissolved organic carbon generally declined during the dark phase, except for the experiments on 19 July and 9 November. Macromolecules were enriched relative to smaller molecules, although they were not refractory against bacterial utilization. Shifts in the patterns of molecular weight distribution suggested that planktonic bacteria preferentially utilized smaller compounds. (Author's abstract)
W85-04672

MICROELEMENT CONTENT OF SOME SUBMERGED AND FLOATING AQUATIC PLANTS,
Botanikai Kutatointezete, Vacratot (Hungary).
M. Kovacs, I. Nyary, and L. Toth.
Acta Botanica Hungarica, Vol. 30, No. 1-2, p 173-185, 1984. 12 Tab, 14 Ref.

Descriptors: *Aquatic plants, *Chemical composition, *Elemental composition, *Microelements, *Lake Balaton, *Hungary, Bioconcentration, Water pollution effects, Heavy metals, Myriophyllum, Ceratophyllum, Duckweed, Potamogeton, Cladophora, Lead, Zinc, Copper, Arsenic, Antimony, Copper, Bismuth, Cesium, Cobalt, Titanium, Dysprosium, Samarium, Neodymium, Iodine, Silver, Scandium.

Aquatic plants are capable of accumulating elements in great quantities that are present in only small quantities in the water or the sediment of lakes. Concentrations of microelements were determined in the most common floating and submerged aquatic herbs and a filamentous algae of Lake Balaton, Hungary. Water samples were taken from the zones of submerged and floating plants in front of reed stands and from the middle of the lake. The concentration of microelements in the plants was 10-1,000,000 times higher than in the environment. The species analyzed for microelements are: Ceratophyllum demersum, Hydrocharis morsus-ranae, Lemna trisulca, Myriophyllum spicatum, Potamogeton pectinatus, P. perfoliatus, Stratiotes aloides and the filamentous alga species Cladophora glomerata. The concentration of each element proved to be a function of the geochemical environment or of environmental pollution, as in the case of Pb, Zn, Cu and As. High content of Sb and Cu (82.02 and 17.45 ppm dry matter, respectively) in C. submersum specimens collected near Balatonalmadi suggest the existence of industrial pollution. Zinc and Cu accumulation in the Badacsony-Szigliget samples of M. spicatum are indicative of vineyard runoff contaminated with Zn- and Cu-containing fungicides. Water-milfoil can take up Zn at a concentration-factor of 1,000,000, wheras this factor is 100,000 for Cs, Co, and Ti. Several microelements, such as Bi, Dy, Cu, Sm, Nd, Ag, I, and Sc were detected only in plants. (Collier-IVI)
W85-04678

RELATIONSHIPS BETWEEN WOODY DEBRIS AND FISH HABITAT IN A SMALL WARMWATER STREAM,
Illinois Univ. at Urbana-Champaign. Dept. of Ecology, Ethology and Evolution.
For primary bibliographic entry see Field 2E.
W85-04679

POSSIBLE RELATIONSHIPS BETWEEN SURFACE WATER CHEMISTRY AND AQUATIC PLANTS IN THE NORTHERN GREAT PLAINS,
South Dakota State Univ., Brookings. Dept. of Biology.
K. K. Sletten, and G. E. Larson.
Proceedings of the South Dakota Academy of Science, Vol. 63, p 70-76, September 1984. 5 Tab, 12 Ref.

Descriptors: *Water quality, *Aquatic plants, *Lakes, *Ecological distribution, Wetlands, Species composition, Alkalinity, Conductivity, Hydrogen ion concentration.

The possibility of establishing relationships between three surface water chemistry parameters and the occurrence of certain aquatic plant species was investigated on 281 wetland sites throughout the northern Great Plains. For the study, 97 species of aquatic plants were selected; selection was based on the direct association of these species with surface water and on the number of sites at which the species were found. The ranges and means of surface-water conductivity, total alkalinity and pH values were determined on a species by species basis. Of the three chemical parameters measured, conductivity of surface water appeared to have the greatest influence on the presence or absence of certain aquatic plants. Five species were found strictly in fresh water while 11 others were tolerant of subsaline conditions. Most species tolerated great variation in alkalinity, while 22 species were found strictly in highly alkaline waters. Little relationship was found between pH and aquatic plant occurrence, although the highest pH readings occurred in subsaline waters and the lowest readings in fresh waters. (Author's abstract)
W85-04697

GROUNDWATER SEEPAGE AND THE WATER BALANCE OF A CLOSED, FRESHWATER, COASTAL DUNE LAKE: LAKE WINDERMERE, JERVIS BAY,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 2F.
W85-04698

OCCURRENCE OF DNA IN RIVER SEDIMENT: ITS MEANING AND RELATIONS WITH BENTHOS RESPIRATION, ORGANIC LOAD AND MACROINVERTEBRATES BIOMASS,
Savoie Univ., Chambery (France). Lab. d'Ecologie.
For primary bibliographic entry see Field 5C.
W85-04699

INFLUENCE OF VARYING ENVIRONMENTAL CONDITIONS ON THE ACTIVITY OF HETEROTROPHIC BACTERIA,
Delta Inst. for Hydrobiological Research, Yerseke

(Netherlands).
A. B. J. Sepers.
Ergebnisse der Limnologie, Vol. 19, p 119-124, December, 1984. 1 Fig, 1 Tab, 5 Ref.

Descriptors: *Bacterial physiology, *Aspartate, *Biomass, *Ecology, Ribonucleic acid, Microorganisms, Respiration.

The heterotrophic bacterial strain HIS 53 was grown in an aspartate limited chemostat and in a continuous culture system at a variable dilution rate. Aspartate was the single carbon, nitrogen and energy source. In these cultures the protein level (biomass parameter), the cellular RNA content (an indication for the physiological state of the cell) and the respiratory capacity for aspartate were measured. The biomass was in all cultures roughly the same, indicating that the applied environmental conditions, including variations in the supply rate of the growth limiting nutrient, did not affect the yield of HIS 53. Due to the inaccuracy of the respiration measurements, the gathered data did not permit definite conclusions about the effects of variable dilution rates on the concentration of the respiratory system. However, there was a trend of higher respiratory capacities at variations in the aspartate addition rate. The variations in the dilution rate brought about higher RNA levels compared with the chemostat cultures. Within the chosen experimental conditions it did not matter if there was a sinusoidal or stepwise variation in the dilution rate. The periodicity in these variations, however, did influence the RNA level. The ecological importance of this increase of the cellular RNA is discussed. (Author's abstract)
W85-04700

MEASUREMENT AND COMPARATIVE VALUES OF THE SHORT CIRCUIT METABOLISM (SCM) OF LAKES BY POC RELATIONSHIP OF PRIMARY PRODUCTION OF PHYTOPLANKTON AND SETTLING MATTER,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
W. Ohle.
Ergebnisse der Limnologie, Vol. 19, p 163-174, December, 1984. 3 Fig, 8 Tab, 12 Ref.

Descriptors: *Cycling nutrients, *Nutrients, *Short circuit metabolism, *Organic matter, *Phytoplankton, *Lakes, Bacteria, Zooplankton, Carbon, Phosphorus, Euphotic zone, Hypolimnion, Sediments, Hypertrophic lakes, Eutrophication, Mineralization.

The biogenic energy flux of lakes is mainly ruled by primary production of phytoplankton and consumption of this potential energy by bacteria. The intensity of these two pathways of energy flux being maintained by participation of zooplankton was identified by determining primary production and the organic remains of organisms collected by traps at different depths of the hypolimnion. The methods used are briefly described. Carbon as well as phosphorus and other nutrient compounds are incorporated in organisms and mineralized again and so forth from two to eighteen times in the euphotic region per unit time, even if neglecting the organic remains deriving from littoral macrophytes and environmental inflow. This Short Circuit Metabolism (SCM) is very variable and specific, however, from lake to lake; strong seasonal changes occur depending on temperature and algal population as well as nutrient level and biogenic dynamics under participation of cladocera, copepods, rotifers and bacteria. The SCM plays a decisive role in the limnetic eutrophication processes, but nevertheless has been generally disregarded. There are euproductive and eudynamic lakes with high bioactivity of 30,000 KJ/sq m/a and more concerning the flux between kinetic and potential energy in the epilimnion. Hypertrophic lakes may have huge bioactivity values up to 70,000 KJ/sq m/a; however, deeper stratified lakes, are also characterized by a surplus of algal products. A great part of the surplus algal products settle out before being mineralized but are then broken down in the bottom sediment by anaerobic bacteria. (Author's abstract)
W85-04701

CARBON MINERALIZATION IN MICROAEROBIC AND ANAEROBIC STRATA OF LAKE VECHTEN (THE NETHERLANDS): DIFFUSION FLUX CALCULATIONS AND SEDIMENTATION MEASUREMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
C. L. M. Steenbergen, and H. Verdouw.
Ergebnisse der Limnologie, Vol. 19, p 183-190, December, 1984. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Carbon, *Cycling nutrients, *Lake Vechten, *Netherlands, *Nutrients, *Sedimentation, Organic carbon, Oxygen, Nitrate, Sulfate, Denitrification.

Input of organic carbon into two profundal strata of Lake Vechten (The Netherlands) during summer stratification in 1982 was estimated using sediment traps suspended at various depths. Concomitantly profiles of electron acceptors (O2, NO3 and SO4) were measured. Dispersion coefficients were estimated on the basis of temperature profiles allowing provisional calculations of fluxes of the electron acceptors. The relation between carbon input and electron acceptor consumption expressed as carbon equivalents for the two strata was evaluated in 4 observation periods. Oxygen consumption dominated in the microaerobic strata during all periods and greatly exceeded the carbon input. Sulfate consumption dominated in the deepest stratum, but did not account for the measured carbon input. It seemed that denitrification occurred in early summer in the deepest stratum. It amounted to only 3-5% of the total electron acceptor consumption. The reliability of this method to estimate decomposition is discussed. (Author's abstract)
W85-04702

COMPARISON OF BACTERIAL SULFATE REDUCTION AND METHANOGENESIS IN THE ANAEROBIC SEDIMENTS OF A STRATIFIED LAKE-ECOSYSTEM,
Limnologisch Inst., Nieuwersluis (Netherlands).
T. E. Cappenberg, C. A. Hordijk, and C. P. M. M. Hagenaars.
Ergebnisse der Limnologie, Vol. 19, p 191-199, December, 1984. 2 Fig, 1 Tab, 14 Ref.

Descriptors: *Bacteria, *Sulfates, *Methane, *Anaerobic conditions, *Sediments, *Lake Vechten, *Netherlands, Sulfur radioisotopes, Isotope studies, Carbon, Mineralization, Nutrients, Lakes.

The importance of bacterial sulfate reduction in the anaerobic mineralization of organic matter in the warm, monomictic, meso-eutrophic Lake Vechten (The Netherlands) was quantified and compared with the rates of methanogenesis and sedimentation of particulate organic matter. Bacterial sulfate reduction was studied directly by using radioactive sulfate and was calculated mathematically by using vertical sulfate gradients at the mud-water interface. Special attention was paid to calculate the actual turnover rates of the various electron acceptors and donors by determining the in situ concentration profiles of these components in the micro M-range using HPLC-fluorescence and - indirect photometric chromatography. Methane production (c. 84-110 mg C/sq m/day) in the sediments and its flux by bubble ebullition and molecular diffusion was compared with the input of carbon by sedimentation (c. 480-940 mg C/sq m/day). The data suggest that sulfate reduction as a terminal process in anaerobic carbon mineralization plays a relatively more important role in freshwater sediments than previously is understood. (Author's abstract)
W85-04703

SEDIMENTOLOGY AND GEOCHEMISTRY OF MODERN SEDIMENTS IN THE KINGSTON BASIN OF LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario).
P. G. Sly.
Journal of Great Lakes Research, Vol. 10, No. 4, p 358-374, 1984. 11 Fig, 6 Tab, 30 Ref.

Descriptors: *Lake sediments, *Kingston Basin, *Lake Ontario, *Geochemistry, *Geomorphology, *Sediments, Nutrients, Heavy metals, Organic carbon, Sulfides, Clays, Iron oxides, Magnesium oxides, Mercury, Cobalt, Zinc, Copper, Phosphorus.

Accumulation of Recent fine sediment is limited to deep water areas in Kingston basin and thickness of more than 50 cm are found only in the St. Lawrence trough; elsewhere, sands and silty sands are largely composed of reworked material. Local sources provide little input of fine sediment to the Kingston basin. Statistical relationships derived from geochemical analyses indicate several forms of association between heavy metals and organic carbon, sulfides, clays, hydrous Fe and Mn oxides, and carbonates. A comparison between Kingston and Niagara sediments shows that the combined effects of riverine and lacustrine erosion have resulted in a generally greater content of carbonates in the Niagara sediments. The content of Fe (which is partly influenced by redox potential) is highest, however, in sediment of the Kingston basin, where higher P values are also associated with an increased clay content. Differences in the concentrations of heavy metals in Lake Ontario, except for Hg, Co, Cu, and Zn, are largely explained by variations in silt and clay contents. Contaminant loadings from the Niagara River are largely responsible for the anomalously high concentrations of Hg and, to a lesser extent, Cu and Zn. Cobalt occurs at higher concentrations in the sediments of eastern Lake Ontario, where its presence is thought to reflect dispersal patterns. (Author's abstract)
W85-04714

SEASONAL VARIATION OF NUTRIENT LIMITATION IN WESTERN LAKE ERIE,
Windsor Univ. (Ontario). Dept. of Biology.
J. H. Hartig, and D. G. Wallen.
Journal of Great Lakes Research, Vol. 10, No. 4. p 449-460, 1984. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Lake Erie, *Seasonal variation, *Limiting nutrients, *Nutrients, Phytoplankton, Phosphorus, Nitrogen, Trace metals, Silica.

Monthly nutrient enrichments were performed from April through October, 1983, to identify growth limiting nutrients of natural phytoplankton assemblages collected from a station in the Pigeon Bay waters off the north shore of Lake Erie's western basin. Data from these experiments suggest that silica was the major limiting nutrient in April, phosphorus was the major limiting nutrient in May-September, and trace metals were limiting in October. These results show that nutrient enrichment experiments should be performed often enough to account for seasonal changes in the physicochemical environment as well as seasonal succession in phytoplankton. The conclusion that phosphorus was the major limiting nutrient in summer is different from the conclusions of the late 1960s and early 1970s that nitrogen was the major limiting nutrient in the summer in the western basin and suggests a possible shift from nitrogen to phosphorus limitation. Pigeon Bay nutrient trend data show that summer nitrate:soluble reactive phosphorus ratios have increased from approximately 4 in the late 1960s to over 40 in the late 1970s and early 1980s, corroborating that a shift has probably occurred. This shift in nutrient limitation is probably due to reduced bioavailable phosphorus loadings and increased nitrate loadings to the western basin. The southern portion of the western basin is physicochemically different from the northern portion and may not have responded in the same manner. (Author's abstract)
W85-04719

MACROINVERTEBRATES AS 'DESCRIBERS' OF MORPHOLOGICAL AND HYDROLOGICAL TYPES OF AQUATIC ECOSYSTEMS ABANDONED BY THE RHONE RIVER,
Programme Interdisciplinaire de Recherche sur l'Environnement - PR2 Rhone.
E. Castella, M. Richardot-Coulet, C. Roux, and P. Richoux.
Hydrobiologia, Vol. 119, No. 3, December, 1984. 3 Fig, 4 Tab, 20 Ref.

Descriptors: *Rhone River, *France, *Macroinvertebrates, *Lones, *River beds, *Ecosystems, Species diversity, Backwater, Molluska, Crustaceans, Insects, Coleoptera, Caddisflies.

Samples of aquatic macroinvertebrates were taken from abandoned beds of the river Rhone in the Bregnier-Cordon area. This sector of the French Upper Rhone is particularly rich in old beds of 'lones' which vary in age and morphological type and have more or less direct connections with the river. Samples were collected using a hand net in eight different 'lones'. The results concerned five groups of fauna: Mollusca, Crustacea, Ephemeroptera, Coleoptera, Trichoptera. The study revealed a wide range of fauna, and the fact that group of taxa can be used to describe types of 'lones' defined by morphological and hydrological characteristics. This kind of research adds to our understanding of how such aquatic ecosystems evolve, and may be applied in a more general way to other important river systems. (Author's abstract)
W85-04722

INTERNAL P LOADING IN LAKES: A DIFFERENT APPROACH TO ITS EVALUATION,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
G. Premazzi, and A. Provini.
Hydrobiologia, Vol. 120, No. 1, p 23-33, January, 1985. 5 Fig, 7 Tab, 26 Ref.

Descriptors: *Phosphorus loading, *Lake sediments, *Italy, *Lake Lugano, *Lake Monate, *Lake Varese, *Lake Alserio, *Lake Pusiano, *Sediment-water interface, Interstitial water, Nutrients, Fate of pollutants, Eutrophic lakes.

Phosphorus release in five different environments was studied in order to evaluate the importance of sediments in determining the P levels in lake water. Sediments of five lakes in the subalpine region of Northern Italy were studied over a two year period: lakes Lugano, Monate, Varese, Alserio, and Pusiano. The laboratory P release rates in Lake Lugano were compared with those evaluated from a mass balance study in situ. The mesotrophic Lake Monate can be considered as a sink for P as it did not show an appreciable release in any experimental condition. The P release in the other lakes is controlled by bacterial activity. In anaerobic conditions the P release was found not to be correlated with the concentration gradient, average interstitial P level or with the forms of P in the sediments. A good correlation was found between the P surface and release rate. The internal P loading can contribute phosphorus to overlying waters at levels comparable to the external sources (from 30 to 100%). Diffusion was found to be the main transport mechanism from aerobic sediments; the diffusional fluxes depend on the concentration gradient between pore and overlying water. When considering the recovery from eutrophication of the investigated lakes, the nutrient release from sediments is of critical importance. The recovery of these lakes following a phosphorus control program could take a long time. (Collier-IVI)
W85-04723

ANALYSIS OF CHANGES IN THE INVERTEBRATE COMMUNITY ALONG A SOUTHERN NEW ZEALAND MONTANE STREAM,
North Canterbury Catchment Board, Christchurch (New Zealand).
B. Cowie.
Hydrobiologia, Vol. 120, No. 1, p 35-46, January, 1985. 2 Fig, 2 Tab, 60 Ref.

Descriptors: *Invertebrates, *New Zealand, *Streams, *Species diversity, *Species composition, Rank correlation, Similarity indices, Population density, Stream biota, Insects, Plecoptera.

Changes in benthic community structure at four sites along a flood-prone montane stream continuum in the South Island of New Zealand were analyzed using rank correlation (Kendall's Tau and Spearman's r sub s) and a community similarity index (S sub c) developed initially for stream pollution assessment. Species richness was highest in a forested headwater stream, which is attributed to its relatively greater physical stability and habitat heterogeneity. Community similarity decreased with distance apart, and pairs of open and forested sites showed the greatest similarity. Species composition and relative abundance along the continuum changed least in the numerically dominant Ephemeroptera and Plecoptera, groups in which several species had broad habitat requirements. In contrast, a number of dipteran and trichopteran species had more restricted distributions. The more specialized niche requirements of some species in these orders are attributed to their generally small size, their ability to spin silk, and their holometabolous development. Physical rather than biological factors appeared to limit the distributions of most invertebrates, and there was little evidence of ecological segregation by either food resource partitioning or differences in life history patterns amongst many closely related species. Theories that stream communities are well ordered entities maximizing the efficiency of energy utilization cannot realistically be applied to such unstable stream systems. (Author's abstract)
W85-04724

METHODS OF PH CALIBRATION OF SEDIMENTARY DIATOM REMAINS FOR RECONSTRUCTING HISTORY OF PH IN LAKES,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
For primary bibliographic entry see Field 5C.
W85-04725

LAKE ONTARIO OXYGEN MODEL. 1. MODEL DEVELOPMENT AND APPLICATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
W. J. Snodgrass, and R. J. Dalrymple.
Environmental Science and Technology, Vol. 19, No. 2, p 173-179, 1985. 2 Fig, 3 Tab, 55 Ref.

Descriptors: *Lake Ontario, *Mathematical models, *Dissolved oxygen, Water circulation, Stratification, Aeration, Photosynthesis, Decomposition, Water temperature, Hypolimnion, Epilimnion.

A mathematical model for dissolved oxygen has been formulated for Lake Ontario. The lake is treated as one box during winter circulation but as two boxes (epilimnion, hypolimnion) during summer stratification; inflows, outflows, vertical transport across the thermocline, atmospheric reaeration, photosynthesis, and decomposition are considered. For each year, temperature data are used to estimate the vertical exchange coefficient and the thermocline depth as a function time. Predictions of the oxygen model show reasonable agreement with observations for a 9-year period. This agreement provides some verification for the model and for the application of the oceanic stoichiometry of Redfield to lakes. Model predictions and observations suggest that oxygen is transported from the hypolimnion to the epilimnion and from the epilimnion to the atmosphere during summer stratification. Vertical transport accounts for ca. 10% of the hypolimnetic loss of oxygen. (Author's abstract)
W85-04801

LAKE ONTARIO OXYGEN MODEL. 2. ERRORS ASSOCIATED WITH ESTIMATING TRANSPORT ACROSS THE THERMOCLINE,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
W. J. Snodgrass.
Environmental Science and Technology, Vol. 19, No. 2, p 180-185, 1985. 5 Fig, 2 Tab, 18 Ref, 1 Append.

Descriptors: *Lake Ontario, *Dissolved oxygen, *Mathematical models, Solute transport, Entrainment, Stratification, Water temperature, Hypolimnion, Epilimnion.

Errors associated with ignoring entrainment of hypolimnetic waters into the epilimnion in two-box models are examined for dissolved oxygen. The effects of entrainment upon modeling and estimating the mass transfer coefficient across the thermocline are also analyzed. Use of Eulerian and semi-Lagrangian box models are contrasted. For epilimnetic dissolved oxygen, neglecting the upward transport of oxygen by entrainment has a maximum error of 5%. A model for estimating the vertical transport coefficient, which uses a heat budget for the hypolimnion and which includes the entrainment process, is developed. For estimation of this coefficient, the temperature either in the hypolimnion or in the thermocline may be used; qualitative arguments are presented for selection of the thermocline temperature. Available data suggest that the entrainment rate in Lake Ontario varies from 1 to 6 m/month and that values for the seasonal vertical transport coefficient are of the order of 0.05-0.1 m/day. (Author's abstract)
W85-04802

DIATOMS OF THE JUKSKEI-CROCODILE RIVER SYSTEM (TRANSVAAL, REPUBLIC OF SOUTH AFRICA): A PRELIMINARY CHECK-LIST,
National Inst. for Water Research, Pretoria (South Africa).
F. R. Schoeman.
Journal of South African Botany (Cape Town), Vol. 48, No. 3, p 295-310, 1982. 2 Fig, 2 Tab, 70 Ref.

Descriptors: *South Africa, *Diatoms, *Jukskei River, *Crocodile River, Benthic flora, Lotic environment, Species composition.

During 1972 to 1975, samples of benthic algae were collected from 22 selected river stations in the Jukskei-Crocodile River system. Some 250 diatom taxa were identified from these samples. The Jukskei-Crocodile River system in the Transvaal embraces an area between Johannesburg on the Witwatersrand in the south and the Hartbeespoort Dam below the Magaliesberg Mountains in the north. The southern catchment area is densely populated and heavily industrialized; the northern part consists mainly of agricultural areas. An alphabetical listing of the diatoms identified is provided. (Baker-IVI)
W85-04814

TEMPERATURE-GROWTH RATE RELATIONSHIPS OF AEROBIC HETEROTROPHIC BACTERIA ISOLATED FROM A SILT-LADEN IMPOUNDMENT,
Orange Free State Univ., Bloemfontein (South Africa). Inst. of Environmental Sciences.
D. F. Toerien.
Journal of the Limnological Society of Southern Africa, Vol. 8, No. 1, p 1-4, 1982. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *South Africa, *Aquatic bacteria, *Reservoirs, Aerobic bacteria, Heterotrophic bacteria, Water temperature, Temperature effect, Bacteria, Growth, Activation energy, Mathematical models.

A quantitative understanding was sought of the temperature-growth rate relationships of bacterial isolates from Wuras Dam (reservoir). While it is known that only a portion of the total bacterial population of aquatic ecosystem can be cultivated on agar plates, development of a quantitative understanding of this relationship should contribute to the overall understanding of the Wuras Dam ecosystem. Activation energies varied from 10.15 to 29.59 kcal/mole, indicating a varied response to temperature changes. Since Q10 values of more than 3.0 were generally encountered, most bacterial isolates were very sensitive to changes in temperature. Increased temperature sensitivity existed for at least some isolates in the lower temperature ranges. The wide temperature ranges of most South African Impoundments coupled with these findings suggest that temperature is probably a major regulating factor for the heterotrophic activity in, and possibly bacterial composition of, these impoundments. (Baker-IVI)
W85-04815

LEAF AREA AS A MEASURE OF STANDING CROP OF FLOATING AQUATIC MACROPHYTES,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
P. C. Keulder.
Journal of the Limnological Society of Southern Africa, Vol. 8, No. 1, p 29-32, 1982. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Standing crops, *Floating plants, *Macrophytes, *Leaf area, Aquatic plants, Salvinia, Azolla, Plant growth, Leaves, Photography.

Leaf area of floating macrophytes as a standing crop is used as a nondestructive additional method for the determination of growth rates. This method is applied to the floating macrophytes Salvinia molesta and Azolla filiculoides. and compared to chloropyll extraction and fresh and dry weight determinations. Growth rates as derived from leaf area determinations agreed with pigment extractions and fresh and dry weight measures of S. molesta and in a reduced scale of A. filicuoides. Leaf area can be applied as an indication of standing crop populations or laboratory monocultures, and growth rates could be calculated from such measurements. The true value of this method lies in its non-destructive nature and the growth and development of a population could be studied without any physical alteration or disturbance. It also yields a permanent photographic record of the population development, which could be useful for later references. (Baker-IVI)
W85-04817

STUDIES ON THE ZOOBENTHOS OF SOME SOUTHERN CAPE COASTAL LAKES. SPATIAL AND TEMPORAL CHANGES IN THE BENTHOS OF SWARTVLEI, SOUTH AFRICA, IN RELATION TO CHANGES IN THE SUBMERGED LITTORAL MACROPHYTE COMMUNITY,
Cape Town Univ. (South Africa). Dept. of Zoology.
B. R. Davies.
Journal of the Limnological Society of Southern Africa, Vol. 8, No. 1, p 33-45, 1982. 6 Fig, 6 Tab, 42 Ref.

Descriptors: *Swartvlei Lake, *South Africa, *Macrophytes, Spatial distribution, Temporal distribution, Coastal waters, Littoral zone, Ecosystems, Invertebrates, Benthic fauna, Species composition.

Swartvlei is the largest of a chain of coastal lakes, lying on the southern tip of Africa, in the Wilderness area between Knysna and George. The lake is oligotrophic, unpolluted, and connected to the Indian Ocean by a shallow meandering estuary. The lake lies on quaternary sands and is of recent origin. Changes which occurred in Swartvlei between 1978 and 1980 were associated with a collapse of the submerged littoral macrophyte community and took the form of a major decline in total standing stocks. This decline was predominantly influenced by a one to two orders of magnitude reduction of the Musculus virgiliae population. A simultaneous change in species composition also took place. Development of epipsammic algal mats subsequent to the die-back of the littoral macrophytes was not sufficient to provide food, and surface area for attachment and shelter from predators and wave action, for the originally predominant suspension-feeding invertebrate community. (Baker-IVI)
W85-04818

FIRE AND HERBIVORY IN A GREAT SALT LAKE MARSH,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 2L.
W85-04825

PREDICTING THE EFFECT OF MACROBENTHOS ON THE SEDIMENT/WATER FLUX OF METALS AND PHOSPHORUS,
Connecticut Univ., Storrs. Biological Sciences Group.
For primary bibliographic entry see Field 2K.
W85-04839

RESPONSES OF BENTHIC MACROINVERTEBRATE SPECIES TO MANIPULATION OF INTERSTITIAL DETRITUS IN CARNATION CREEK, BRITISH COLUMBIA,
Calgary Univ. (Alberta). Dept. of Biology.
J. M. Culp, and R. W. Davies.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 1, p 139-145, January, 1985. 6 Fig, 2 Tab, 29 Ref.

Descriptors: *Detritus, *Invertebrates, *Carnation Creek, *British Columbia, Benthic fauna, Ecological distribution, Biomass, Microbial degradation, Interstitial detritus.

Experimental manipulations were conducted in Carnation Creek, British Columbia, to determine the response of macroinvertebrate distribution and abundance to differences in detritus source and quantity. Four treatments (no detritus, low hemlock (Tsuga heterophylla), low alder (Alnus rubra), high alder) with a standardized substrate were established in a riffle and left for 28 d. Densities and/or biomasses of 12 of the 20 colonizing macroinvertebrate taxa were significantly different among the detritus treatments. Microbial activity, detritus processing, and macroinvertebrate abundances were highest in substrate patches with alder detritus. Compared with the no detritus and low hemlock treatments, the low alder treatment increased the abundances of nine taxa and decreased three taxa, while the high alder treatment increased the abundance of six taxa and decreased six taxa. Thus, detritus source and quantity strongly influenced macroinvertebrate community composition within the streambed. Although most of the macroinvertebrates in all treatments were either collector-gatherer or shredder detritivores, these macroinvertebrates responded to changes in detritus in a species-specific manner. Therefore, the Carnation Creek experiments emphasize the importance of interstitial detritus in the substrate as a factor that influences the microdistribution of the benthos at the species, rather than trophic feeding, assemblage level. (Author's abstract)
W85-04841

QUANTIFICATION OF STREAM DRIFT,
Maryland Univ., College Park. Dept. of Zoology.
J. D. Allen, and E. Russek.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 210-215, February, 1985. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Drift, *Invertebrates, *Sampling, Mayflies, Streams, Aquatic animals.

Although the purpose of many drift studies is to describe quantitatively the abundance of drifting invertebrates and make comparisons between seasons or sites, almost no investigations have employed replicate sampling. Drift collections from a Rocky Mountain stream were analyzed in order to investigate the variability of drift sampling. The data were normalized and the variances stabilized for each taxon examined by data transformation. The fourth root transformation was favored for five taxa and the logarithmic transformation for three. Using the 95% confidence limits on 24-h drift density for an abundant mayfly (Baetis bicaudatus), it is found that six to seven replicates are required to obtain 95% CL +/- 50% of the mean. Drift sampling appears to require fewer replicates than benthic sampling for comparable precision. Investigators may fail to replicate drift samples because they elect to sample frequently over 24 h in order to quantify the diel periodicity of drift. However, when comparison between sites or dates is the principal goal, it is recommended that the effort normally put into frequent sampling over 24 h be invested instead in replicated sampling just after dark, when drift normally is greatest. When drift from the first night sample was regresses against total drift from the remainder of the 24-h period, 60-90% of the variation in the latter was predicted from the single nighttime sample. Thus, little information appears to be lost by this recommended procedure. (Author's abstract)
W85-04842

MODELLING WINTER OXYGEN DEPLETION RATES IN ICE-COVERED TEMPERATE ZONE LAKES IN CANADA,
Alberta Univ., Edmonton. Dept. of Zoology.
J. Babin, and E. E. Prepas.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 239-249, February, 1985. 5 Fig, 7 Tab, 34 Ref.

Descriptors: *Oxygen depletion, *Iced lakes, *Alberta, *Manitoba, *Ontario, Mathematical equations, Model studies, Dissolved oxygen, Phosphorus, Productivity, Chlorophyll a, Ice cover.

Winterkill is a common phenomenon in lakes in central Alberta, so considerable interest exists in factors controlling winter oxygen depletion rates (WODR) in these lakes. WODR were determined for 13 lakes in central Alberta during the winter of 1982-83. The lakes are located in central Alberta within a 160-km radius of Edmonton. Just prior to freeze-up, dissolved oxygen levels were surprisingly low in 12 of the 13 lakes. Although dissolved oxygen decreased in all lakes for the first 3.5 mo after freeze-up, the decreases were nonlinear. The highest WODR were observed just after freeze-up. The nonlinear WODR were significantly correlated with two estimates of lake productivity (total phosphorus (TP) and chlorophyll a) but were not significantly correlated with morphometry. When the WODR from the Albertan lakes were treated as linear, to enable a comparison with other studies, correlations were found between WODR and morphometry, and WODR and estimates of summer productivity. These relationships were significantly different from observations by previous investigators who worked on ice-covered lakes in two other regions. To develop a model to predict WODR over a wide range of lake types, estimates of WODR, open-water productivity, and morphometry from 48 lakes in Alberta, Ontario, and Manitoba were combined. Estimates of productivity were stronger single predictors of WODR than morphometry. An equation was developed which permits the prediction of WODR for a greater range of lake types than previous models. (Moore-IVI)
W85-04843

GAS SUPERSATURATION AS A CAUSE OF EARLY SPRING MORTALITY OF STOCKED TROUT,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. A. Mathias, and J. Barica.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 268-279, February, 1985. 6 Fig, 5 Tab, 27 Ref.

Descriptors: *Trout, *Mortality, *Supersaturation, Iced lakes, Dissolved oxygen, Fish stocking, Freezing, Nitrogen, Freeze-out, Gas bubble disease, Fishkill, Ice cover.

Rainbow trout (Salmo gairdneri) fingerlings, stocked through the ice of shallow prairie lakes, experienced high mortality even though algal photosynthesis had returned whole-lake oxygen concentrations to normal levels prior to ice melting. Fish caged beneath the ice showed symptoms of asphyxiation or gas bubble disease, depending on depth. Asphyxiation occurred at oxygen concentrations below 4 mg/L. Total dissolved gas tension is identified as the primary cause of bubble disease and resulting mortality, and the relative contributions of oxygen and nitrogen to total gas tension are demonstrated. Significant mortalities were associated with oxygen relative partial pressures (gas partial pressure relative to total hydrostatic pressure) exceeding 0.2, but only when accompanied by nitrogen relative partial pressures above 1.1. Total relative gas tension under these circumstances exceeded 1.3. An increase in nitrogen partial pressures over the winter was attributed to the physical freeze-out of nitrogen from the ice in shallow lakes where reduction of lake volume due to ice formation is substantial. (Author's abstract)
W85-04844

CELLULAR PHOSPHORUS CONCENTRATION AS A CRITERION FOR TROPHIC STATUS IN RAPIDLY FLUSHED LAKES,
Maine Univ. at Orono. Land and Water Resources Center.
P. D. Uttormark, and M. L. Hutchins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 300-306, February, 1985. 5 Fig, 7 Ref.

Descriptors: *Phosphorus, *Algae, *Trophic level, *Flushing, Lakes, Washout, Mathematical equations, Nutrients, Aquatic plants.

Mass balance equations for calculating steady-state P concentrations have been used to estimate the degree of P abatement necessary to achieve various levels of water quality improvement, including the reduction of algal populations. The relationship between steady-state P values and the severity of problems due to excessive algal growth potentially breaks down for lakes with high flushing rates. For these lakes, cellular losses throught the outlet reduce algal populations to levels below that which could be supported by the amount of P present. By using the steady-state concentration of cellular phosphorus (P) as the indicator of a lake's trophic status, equations are derived that describe the flushing rate at which cellular washout might be expected, and the range of flushing rates in which cellular P concentrations would be reduced significantly below those of total P. Calculated concentrations of cellular P and total P are virtually identical for lakes with flushing rates below about 10/yr; at higher rates they may differ substantially. The transfer of P from available to cellular forms is described by Michaelis-Menten growth kinetics. Periphyton and rooted aquatic plants are not subject to washout, so that problems due to excessive plant growth are possible even though populations of pelagic algae may be reduced. (Moore-IVI)
W85-04846

RADIOTRACER ESTIMATION OF MICROBIAL BIOMASS IN LAKE SEDIMENT,
East-West Environment and Policy Inst., Honolulu, HI.
G. G. Marten.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 373-379, February, 1985. 6 Fig, 20 Ref.

Descriptors: *Carbon radioisotopes, *Biomass, *Microorganisms, *Lake sediments, Radioactive tracers, Marion Lake, British Columbia, Sediments.

The measurement of biomass with radiotracers is based upon the principle that, given sufficient time, a radiotracer will distribute itself throughout an ecosystem in proportion to the element it is tracing. If a carbon tracer is introduced to a sediment core sample, the tracer should eventually distribute itself in proportion to the actively circulating carbon in the core. The vertical distribution of the tracer should reflect the vertical distribution of actively circulating carbon in the sediment core, and the distribution of tracer between particulate and dissolved fractions should reflect the amount of carbon in living biomass compared with other froms of actively circulating carbon. This method was applied to sediment from Marion Lake, British Columbia. Most of the sediment microorganisms were concentrated in the top 2 cm of sediment, where the total biomass of microorganisms was estimated to be 183 micro-g C/sq cm. The radiotracer estimate compared favorably with independent measurements based on ATP and direct microscopic counts of sediment microorganisms. (Moore-IVI)
W85-04848

INFLUENCE OF LIGHT ON THE ALKALINE PHOSPHATASE ACTIVITY OF SELENASTRUM CAPRICORNUTUM (CHLOROPHYCEAE) IN STREAMS,
State Univ. of New York Coll. at Cortland.
R. L. Klotz.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 384-388, February, 1985. 2 Fig, 5 Tab, 34 Ref.

Descriptors: *Selenastrum, *Solar radiation, *Alkaline phosphatases, Streams, Algal growth, Phosphates, Limiting nutrients, Enzymes.

Algae respond to limiting inorganic P conditions by producing alkaline phosphatases which cleave inorganic phosphate groups from certain organic P compounds, making them available to the algae. High alkaline phosphatase activity (APA) does not necessarily indicate P limitation, for there may be sufficient enzyme hydrolyzable phosphate in the water for the algae. Selenastrum capricornutum, originally isolated from a river, was incubated in dialysis chambers in situ in four streams in New York State and analyzed for APA and growth rate. Selenastrum APA increased with the degree of shading. APA was inversely related to total insolation when measured under controlled conditions in the same stream reach. APA was not correlated with stream molybdate reactive phosphorus over the range of concentrations encountered. Selenastrum showed no diel cycle of APA. The phosphorus fraction made available by the activity of alkaline phosphatases, enzyme hydrolyzable phosphorus (measured for the first time in streams), increased the phosphorus supply to organisms with high APA. If APA can be considered a good measrue of P limitation, then the mechanism responsible for increased APA under low light intensity may be linked to P uptake, which is an energy-dependent reaction. (Moore-IVI)
W85-04849

PHYSICAL MODEL OF THE AQUATIC ECOSYSTEM,
Moscow State Univ. (USSR). Dept. of Marine Physics.
V. V. Alekseev, A. O. Kokorin, and M. Ya. Lyamin.
Ecological Modelling, Vol. 25, No. 1/3, p 31-46, October, 1984. 6 Fig, 20 Ref.

Descriptors: *Model studies, *Ecosystems, *Aquatic environment, Dissolved oxygen, Phosphates, Nitrates, Hydrogen ion concentration, Mathematical models.

The basic facts on ecosystems have been obtained by observations in nature. Observation is an essential preliminary in any study but to be most effective, experiments are necessary to obtain as much quantitative information as possible and enable the development of a mathematical model of a given phenomenon. In this paper the experimental ecological installation 'ETECOS' is described. It is a physical model of a freshwater reservoir (36 cu m in volume) with the basin and the air chamber above it isolated from the environment. The results of ecological experiments are presented. It has been possible to obtain a vertical distribution pattern of oxygen, phosphates, nitrates, pH and other hydrochemical parameters, predominantly due to biochemical processes where the role of water dynamics is insignificant. On the basis of the experiments conducted on the ETECOS, a mathematical model was constructed, which imitated the gaseous regime of a freshwater reservoir during the warm spring-summer period. The model took account of the processes of diffusion, photosynthesis, oxidation, sedimentation of algae to the bottom, its growth and die-off. Theoretical data obtained by means of the mathematical model are in good agreement with experimental results. A method of describing the physical and biological processes in a reservoir has been suggested, and some numerical characteristics presented. (Author's abstract)
W85-04850

QUIESCENCE, GROWTH AND SENESCENCE OF EGERIA DENSA IN LAKE MARION,
Clemson Univ., SC. Dept. of Botany.
K. D. Getsinger, and C. R. Dillon.
Aquatic Botany, Vol. 20, No. 3-4, p 329-338, December, 1984. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Elodea, *Lake Marion, *South Carolina, Reservoirs, Macrophytes, Population dynamics, Seasonal variation, Plant growth, Aquatic plants, Aquatic weeds.

The submersed aquatic macrophyte Egeria densa (Brazilian elodea) has become a prominent weed in lakes and rivers of the southeastern US. The life history of the plant, E. densa, and the timing of its growth phases in Lake Marion were investigated. Lake Marion is a 39,366 ha hydroelectric reservoir in the Santee-Cooper River System, located in the coastal plain of South Carolina. It has a mean depth of 4 m and a mean hydraulic retention time of 44 days. Summer plants comprised both aged stems and new parts produced in the spring and summer of 1980. In June, new growth consisted of stems with 1, 2, and 3 degree branches. Quaternary branching occurred from July through September. Autumn was characterized by the production of new branches from summer stems and of new stems from the rootcrowns. Winter was marked by the proliferation of new, short stems (an average of 9.9 per rootcrown). Spring was marked by an acceleration of growth. Aged parts deteriorated rapidly. Prior to penetration of the sediment, roots produced from elevated double nodes were devoid of root hairs, which were produced subsequently. The success of Egeria in South Carolina is a function of its ability to reproduce vegetatively by means of specialized structures such as rootcrowns or double nodes, and to initiate a growth resurgence following sloughing and fragmentation induced by exposure to the stress of elevated surface water temperatures. (Baker-IVI)
W85-04858

BIOLOGY OF BRACHYCENTRUS SUBNUBILUS CURTIS (TRICHOPTERA) IN THE RIVER FROME, DORSET,
Freshwater Biological Association, Wareham (England). River Lab.
R. J. M. Gunn.
Hydrobiologia, Vol. 120, No. 2, P 133-140, January, 1985. 6 Fig, 3 Tab, 23 Ref.

Descriptors: *Caddisflies, *Brachycentrus, *Aquatic weed control, *River Frome, *England, Larval growth stage, Aquatic plants, Macrophytes, Life history studies.

The caddisfly Brachycentrus subnubilus was studied in the River Frome, England. Data were collected on the life-history, oviposition and microdistribution within beds of Ranunculus penicillatus var. calareus. B. subnubilus has one generation each year, with five larval instars. Larvae favor sites beneath the weedbeds for most of the year, migrating to more exposed areas in the spring to pupate. Pupation, emergence, oviposition and eclosion are completed in just over two months. Eggs are usually laid on submerged marginal vegetation but any semi-submerged object may be utilized. Larvae appear to disperse mainly as first instars. Initial development is rapid to fourth instar. Larvae overwinter as fifth instars. Sex ratios show a predominance of males. The weedcutting activity in the River Frome must seriously affect the population of B. subnubilus; each of two weedcuts every year removes about 2/3 of the plant material from 43 km of river. While disturbed larvae may drift and find new sites of attachment, the practice of cutting progressively downstream must cause larvae to be disturbed repeatedly. (Moore-IVI)
W85-04887

NITRATE CYCLING IN LAKE TITICACA (PERU-BOLIVIA): THE EFFECTS OF HIGH-ALTITUDE AND TROPICALITY,
California Univ., Davis. Inst. of Ecology.
W. F. Vincent, C. L. Vincent, M. T. Downes, and P. J. Richerson.
Freshwater Biology, Vol. 15, No. 1, p 31-42, February, 1985. 8 Fig, 4 Tab, 23 Ref.

Descriptors: *Nitrates, *Cycling nutrients, *Altitude, *Tropical zone, *Lake Titicaca, *Peru, *Bolivia, Dissolved oxygen, Stratification, Anoxic conditions, Mixing, Nitrification, Denitrification, Lake sediments.

The vertical distribution of dissolved oxygen and inorganic nitrogen differed considerably between three stratification cycles in Lake Titicaca, a tropical lake (latitude 16 degrees S) in the high Andes

(3800 m altitude). In 1980/81 an anoxic layer of water extended from 200 to 275 m and contained high levels of NH4 but zero NO3. During the annual deep mixing period in 1981 this layer was substantially eroded, and was completely eliminated during deep-mixing in 1982. Nitrapyrin assays of nitrification demonstrated highest activity in the surface mixed layer, lowest activity just beneath the thermocline, and then increasing nitrification rates with increasing depth towards the bottom anoxic zone. Denitrification rates were slow, but detectable, in the surficial sediments of Lake Titicaca during late 1982. Much faster rates were estimated for the water column anoxia. Lake Titicaca is a productive lake with low saturation levels of oxygen because of its high altitude. These features favor hypolimnetic anoxia, and thus denitrification which varies in magnitude from year to year. (Author's abstract)
W85-04896

ZOOPLANKTON DYNAMICS IN LAKE MENDOTA: SHORT-TERM VERSUS LONG-TERM CHANGES,
Universidad Autonoma de Barcelona (Spain). Dept. de Microbiologia.
C. Pedros-Alio, and T. D. Brock.
Freshwater Biology, Vol. 15, No. 1, p 89-94, February, 1985. 1 Fig, 2 Tab, 11 Ref. NSF grants DEB 82-12450 and DEB 8012313.

Descriptors: *Zooplankton, *Population dynamics, *Lake Mendota, *Wisconsin, Eutrophic lakes, Standing crop, Crustaceans.

Lake Mendota, Wisconsin is highly eutrophic and has been the object of extensive research over the past 100 years. Data from a study of zooplankton dynamics in Lake Mendota for the years 1976-80 were compared with those of E. A. Birge, obtained in the years 1894-96. The zooplankton annual cycles and sizes of standing crop were similar in both studies. There was more year-to-year variation within each study than there was between the two studies separated by over 80 years. Statistical comparison indicates that 1895 was very diffferent from 1896 and close to 1978. Also, 1976 differed more from 1979 and 1980 than from 1895 and 1896. Certain species were much more common in some years than in others; this indicates the importance of study over a number of years before any conclusions can be made about long-term changes in a lake ecosystem. As far as species of crustacean zooplankton are concerned, Lake Mendota is quite similar now to what it was 80 years ago. (Moore-IVI)
W85-04897

SHREDDER ABUNDANCE AND LEAF BREAKDOWN IN AN APPALACHIAN MOUNTAIN STREAM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.
E. F. Benfield, and J. R. Webster.
Freshwater Biology, Vol. 15, No. 1, p 113-120, February, 1985. 3 Tab, 45 Ref.

Descriptors: *Leaves, *Stream order, *Invertebrates, *Shredders, Decomposition, Mountain streams, Feeding rates.

Low-order streams in deciduous woodlands are known to be energetically dependent on leaf material from riparian vegetation. Biological processing of leaf material in most cases follows the general sequence of leaching followed by microbial colonization and conditioning and invertebrate feeding. Breakdown rates of dogwood, red maple and white oak leaves were investigated at two first-order and two second-order sites in an Appalachian Mountain stream. Leaves exposed in mesh bags were sampled on eight occasions over a 207 day period and breakdown rates were compared using an exponential decay model. There was a consistent ranking in leaf breakdown rate within each site, i.e. dogwood > red maple > white oak, and all species broke down faster at second-order than at first-order sites. Shredder number and density were analyzed for a leaf species effect within each site on each sampling date. Shredder number and density were also analyzed for site differences for each leaf species on each sampling date. Significant site effects occurred on about 70% of the dates. When all leaf species were combined at each site, shredder number and density were significantly higher at the two second order sites. Differences in species-specific leaf breakdown rates were apparently largely a function of shredder abundance on the leaves. (Moore-IVI)
W85-04899

MODEL OF DIATOM DYNAMICS IN THE EPILIMNION OF LAKE JEZERO ON THE ISLAND OF KRK,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
T. Legovic, and D. Justic.
Periodicum Biologorum, Vol. 86, No. 3, p 269-276, November, 1984. 5 Fig, 7 Ref.

Descriptors: *Diatoms, *Population dynamics, *Orthophosphates, *Yugoslavia, *Lake Jezero, Primary productivity, Phytoplankton, Epilimnion, Hydrologic budget, Phosphorus.

Lake Jezero is a small and shallow accumulation on the island of Krk (Yugoslavia). Since the lake is largely used for water supply, it is important to assess the main factors controlling primary productivity, which in turn affects the quality of the water. There are two dominant phytoplankton groups in the lake: diatoms and dinoflagellates. A water balance and an orthophosphate-phosphorus balance were calculated. A model explaining dynamics of diatoms versus orthophosphate was constructed. The model includes: uptake of orthophosphate, based on the Michaelis-Menten function and limitation by light; sinking of diatoms; variable inflow of orthophosphate; outflow of orthophosphate and diatoms from the lake. The nominal dynamics of the model reasonably agrees with measured orthophosphate and diatom concentrations. In the model, biomass of diatoms attained a maximum of 1.25 mg p/cu m at the beginning of June, a week earlier than the peak in the data. (Moore-IVI)
W85-04900

EFFECTS OF ECOLOGICAL PERTURBATIONS ON DIATOM DYNAMICS IN THE MODEL OF LAKE JEZERO,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
T. Legovic, and D. Justic.
Periodicum Biologorum, Vol. 86, No. 3, p 277-286, November, 1984. 12 Fig, 6 Ref.

Descriptors: *Diatoms, *Orthophosphates, *Lake Jezero, *Yugoslavia, Lakes, Population dynamics, Mathematical models, Solar radiation, Inflow.

A mathematical model developed to simulate orthophosphate and diatom dynamics in Lake Jezero, Yugoslavia was analyzed at nominal and perturbed states. An assessment is given of the effect that various ecological parameters have on the dynamics of orthophosphate and diatom concentrations in Lake Jezero. The following parameters were analyzed: lake volume, inflow, orthophosphate concentration in the inflow, sinking of diatoms, maximum assimilation rate, half-saturation constant and timing of the light optimum. Special attention was payed to the appearance of two biomass maximums which result as a consequence of an increase of orthophosphate in the inflow, a decrease in half-saturation constant or a delay in optimum light conditions. A general result which follows from perturbation trials is that it is necessary to know ecological properties of the present biological species in the lake as well as the water and phosphorus balance in order to be able to predict the most likely outcome of planned management procedures. (Moore-IVI)
W85-04901

SEDIMENT COMPOSITION, MUD-WATER INTERCHANGES AND THE ROLE OF MACROPHYTES IN DAL LAKE, KASHMIR,
Kashmir Univ., Srinagar (India). Dept. of Botany.
C. L. Trisal, and S. Kaul.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 671-682, 1985. 7 Fig, 2 Tab, 20 Ref.

Descriptors: *Lake sediments, *Macrophytes, *Mud-water interfaces, *Dal Lake, *India, Cycling nutrients, Nitrogen, Phosphorus, Potassium, Carbon, Seasonal variation, Plant growth, Aquatic plants, Decomposition.

An attempt was made to follow the changes in the concentration of nutrients both in the particulate sediments and water of Dal Lake, Kashmir. Twelve station were selected in different basins of Dal Lake where sediment, water, macrophyte and phytoplankton samples were collected monthly for a year. The particulate phase of lake sediments showed a marked reduction in the concentration of N, P, K and C during late spring and summer. Larger amounts of these elements were found towards the autumn, and these higher levels were maintained through winter until early spring. The reduction in the concentration of these mineral nutrients was greatest during the growing season of the macrophytes considerable quantities of these nutrients are thus released at times of biological growth. These losses from the sediments are not reflectd in increased concentrations of the nutrients in the water. Autotrophic utilization of the nutrients provides a biological sink resulting in their lower concentrations in the sediments. The concentrations of these nutrients in the sediments increase during the fall due to microbial decomposition, adsorption, deposition and subsequent partial mineralization of large quantities of dead plant material. (Moore-IVI)
W85-04904

QUALITATIVE AND QUANTITATIVE ENTOMOFAUNISTIC INVESTIGATION OF AN OPENCAST RESIDUAL LAKE NEAR LEIPZIG (GDR),
Karl-Marx-Univ., Leipzig (German D.R.). Sektion Biowissenschaften.
U. Jacob, B. Klausnitzer, and H. Walther.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 701-713, 1983. 8 Fig, 6 Tab, 14 Ref.

Descriptors: *Aquatic insects, *Kulkwitz Lake, *Germany (Democratic Republic), *Opencast residual lakes, Lakes, Surface mines, Physicochemical properties, Land reclamation.

The desire to put water-filled lignite opencast residual pits to some practical use makes it necessary to obtain sufficiently exact knowledge of such artificially enclosed waters which, in contrast to the terrestrial landscape left behind after closing down lignite mines, are subject mainly to spontaneous colonization. The Kulkwitz lignite opencast mine in the Leipzig lignite district (German Democratic Republic) was closed down in 1962. The lake was banked up in 1960/61, and its water level is still 3 m below the projected level. The physico-chemical characteristics of the water were recorded and qualitative and quantitative entomofaunistic inventories carried out. A floating emergence trap was used, which caught a total of 8,397 insects above a water area of 2.25 sq m during the summer and autumn of 1979. These insects belong to 12 families and 4 orders. For the littoral, the 3,733 emerging insects/sq m/yr can be considered a minimum. The Chironomidae account for 3,204 of this number, followed by Trichoptera (369), Brachycera, Ephemeroptera, and Odonata. For the Trichoptera, the structure of dominance, diversity and equity are very low due to the eudominance of Ecnomus tenellus. (Moore-IVI)
W85-04906

RESPONSES OF THE PHYTOPLANKTON COMMUNITY OF A TROPICAL RESERVOIR (SAO PAULO, BRAZIL) TO THE ENRICHMENT WITH NITRATE, PHOSPHATE AND EDTA,
Universidade Federal de Sao Carlos (Brazil). Lab. of Limnology.
R. Henry, and J. G. Tundisi.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 6, p 853-862, 1983. 4 Fig, 3 Tab,

25 Ref.

Descriptors: *Nitrogen, *Phosphates, *EDTA, *Phytoplankton, *Lobo Reservoir, *Brazil, Limiting nutrients, Reservoirs, Suspended solids, Chlorophyll a, Trace metals,.

An enrichment experiment was conducted in Lobo Reservoir (Sao Paulo, Brazil) to investigate nitrogen and phosphorus as possible limiting factors and the action of EDTA on phytoplankton growth. Samples of surface water from the oligotrophic region of the reservoir with their phytoplankton populations were placed in flasks. KNO3, KH2PO4 and EDTA were added at two concentrations. After 14 days of in situ incubation, the amounts of suspended matter and chlorophyll a, the carotene/chlorophyll ratio, and the phytoplankton cell counts were recorded for all the water samples. The addition of nitrate and phosphate to water samples produced significant effects on the chlorophyll a and cell counts, while EDTA acted only on the cell production. Both nitrate and phosphate, when analyzed individually, caused a decrease in the value of the carotene/chlorophyll ratio. There was synergistic effect of the addition of EDTA and N on the suspended matter. A three-way interaction of enrichment by EDTA + N + P was responsible for a significant increase in cell counts. The EDTA probably made trace metal chelation and assimilation possible. This did not affect chlorophyll biosynthesis. (Moore-IVI)
W85-04908

BLUE-GREEN DOMINANCE IN LAKES: THE ROLE AND MANAGEMENT SIGNIFICANCE OF PH AND CO2,
Minnesota Univ., Minneapolis. Limnological Research Center.
J. Shapiro.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 765-780, 1984. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Cyanophyta, *Chlorophyta, *Carbon dioxide, *Hydrogen ion concentration, Nutrients, Water circulation, Lakes, Lake management, Competition, Cyanophages.

Field and laboratory experiments show that when nutrients (N and P) are added to a mixed population of algae, blue-greens predominate. However, if CO2 is added also, or if pH is lowered with HCl, greens predominate. The phenomenon is reproducible, and works with most lakes. Although most successful at pH 5.5, the shift to greens can be made to happen at pH values as high as 8.5. Most blue-greens appear to susceptible to the shift, and Scenedesmus and Chlorella are the predominant greens resulting. If pH is raised, the shift is reversed. The reason for the shift is not known. It may involve competition by the algae for CO2, but other evidence suggests that the lowered pH stimulates cyanophage production and lysis of the blue-greens, with release of nutrients which then are used by the greens. Analysis of results of lake circulation data from the literature and from experiments suggests that the algal shifts resulting from circulation may involve the same phenomena. Understanding of these phenomena should lead to predictable use of circulation as a lake-management tool. (Author's abstract)
W85-04909

EXPERIMENTAL LAKE FERTILIZATION IN THE KUOKKEL AREA, NORTHERN SWEDEN. PHYTOPLANKTON BIOMASS AND ALGAL COMPOSITION IN NATURAL AND FERTILIZED SUBARCTIC LAKES,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
S. K. Holmgren.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 781-817, 1984. 7 Fig, 16 Tab, 81 Ref.

Descriptors: *Phytoplankton, *Biomass, *Subarctic lakes, *Algae, *Nutrients, Sweden, Nitrogen, Phosphorus, Species composition, Seasonal variation, Wind, Solar radiation, Water temperature.

Four small subarctic lakes in the Kuokkel area near Abisko in northern Sweden were used to study the effects of artificially increased N and P loadings. Based on 500 quantitative algal analyses from 1971-1980, the seasonal variations of phytoplankton biomass and species diversity were evaluated. Seasonal average phytoplankton biomass was positively correlated to nutrient concentrations and negatively to wind speed, while no correlations were found with temperature, insolation, and length of the vegetation period. Enrichment with P alone did not cause any biomass increase and inhibited dinoflagellates and Dinobryon. Enrichment with N alone stimulated Uroglena and Gymnodinium and the biomass increased. No species were inhibited. Enrichment with both N and P made the biomass increase 50-60 times. In all fertilized lakes monocultures of chlorococcal green algae finally developed. When the fertilizations ceased the algal biomass and species composition returned to close to normal by the next year. When nutrients are available, the phytoplankton in subarctic lakes can build up to about the same biomasses as in temperate and tropical lakes, in spite of low temperature, poor light conditions, and a short vegetation period. (Moore-IVI)
W85-04910

COMPARISON OF PLANKTON-WATER CHEMISTRY RELATIONSHIPS IN THREE ACID STRESSED LAKES IN NOVA SCOTIA, CANADA,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
A. C. Blouin, P. A. Lane, T. M. Collins, and J. J. Kerekes.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 819-841, 1984. 2 Fig, 7 Tab, 37 Ref. Canadian Wildlife Service contracts OSC80-00057, OSC81-00129 and OSC81-00210.

Descriptors: *Plankton, *Acid precipitation, *Kejimkujik Lake, *Pebbleloggitch Lake, *Beaverskin Lake, *Nova Scotia, Oligotrophic lakes, Dystrophic lakes, Chemical properties, Algae, Zooplankton, Biomass.

A field program was conducted in 1980 and 1981 on three lakes in Kejimkujik National Park, Nova Scotia, to study plankton-water chemistry relationships in a region of potential acid precipitation stress. Among lake and between year comparisons were made. The three study sites represent two different types of lakes. Kejimkujik Lake (pH 4.8) and Pebbleloggitch Lake (pH 4.5) are both high-colored, dystrophic acid lakes. Beaverskin Lake is a clear, oligotrophic lake which is not as acidic (pH 5.4). The phytoplankton of Kejimkujik Lake was dominated by diatoms which Pebbleloggitch Lake was dominated by chlorophytes and chrysophytes, and Beaverskin Lake was dominated by cyanophytes. Kejimkujik Lake had the highest total algal cell volume per liter, and Pebbleloggitch Lake the lowest. Rotifer populations composed the majority of the zooplankton communities, while the crustacean zooplankton were dominated by the acid-tolerant copepod Diaptomus minutus. Kejimkujik Lake had the lowest zooplankton biomass and Pebbleloggitch Lake the highest zooplankton biomass per cu m. A pattern of highest algal density in Beaverskin Lake, but highest zooplankton density in Pebbleloggitch Lake emerged in both years. This is likely an effect of abundant, but unsuitable food (blue-green algae) in Beaverskin Lake and important detrital food resources in Pebbleloggitch Lake in both years. Multiple regression analysis of water chemistry variables with plankton species produce many significant effects, but failed to show clear patterns. Cause and effect relationships in aquatic ecosystems are poorly delineated by such techniques. (Author's abstract)
W85-04911

SEASONAL VARIATIONS IN FOUR BACTERIAL SIZE FRACTIONS FROM A HYPERTROPHIC POND IN TOKYO, JAPAN,
Tokyo Metropolitan Univ. (Japan). Dept. of Biology.
T. Konda.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 843-858, 1984. 8 Fig, 51 Ref.

Descriptors: *Plankton, *Bacteria, *Seasonal variation, Suspended solids, Particulate matter, Microcystis, Biomass.

The planktonic bacterial populations in the surface water of the hypertrophic Himon-ya Pond (Japan) were separated into four fractions (> 35 micro-m, 35-5 micro-m, 5-1 micro-m, and < 1 micro-m) by size fractionation of suspended particles in the water. The seasonal variations in bacterial numbers over a two year period differed for each of the four fractions. The bacterial counts in the >35 micro-m fraction were mainly dependent on the biomass of Microcystis colonies. Their peaks were observed in summer. In the 35-5 micro-m and 5-1 micro-m fractions, several peaks in bacterial numbers were observed, influenced by the quality and quantity of the particles associated with the bacteria. The bacterial counts in the < 1 micro-m fraction contributed a high proportion of the total throughout all seasons except summer. (Author's abstract)
W85-04912

COLORADO COOPERATIVE FISHERY RESEARCH UNIT STUDIES OF TWIN LAKES, COLORADO: 1980 REPORT OF FINDINGS,
Colorado Cooperative Fishery Research Unit, Fort Collins.
For primary bibliographic entry see Field 5C.
W85-04937

2I. Water In Plants

RAINFALL INTERCEPTION ON A SMALL FORESTED WATERSHED WITHIN THE KAWARTHA LAKES REGION,
Kawartha Region Conservation Authority, Fenelon Falls (Ontario).
T. Mathers, and C. H. Taylor.
Canadian Water Resources Journal, Vol. 8, No. 1, p 120-129, 1983. 1 Fig, 1 Tab, 17 Ref.

Descriptors: *Vegetation, *Interception, *Rainfall, *Ontario, Forest watersheds, Throughfall, Stemflow, Rainfall disposition, Trees, Mathematical equations.

Plants that intercept precipitation alter its amount, timing and areal distribution, as well as the quality of the water input to the basin as a hydrologic system. In order to quantify the disposition of precipitation by vegetation within the Kawartha Lakes region (Ontario), precipitation, interception, soil moisture and streamflow data were collected on a small forested watershed from September 13, 1977 to September 12, 1978. The watershed is approximately 47 ha in size. Trees cover approximately 60% of the total basin area. The remainder of the basin consists of open pasture and cultivated fields. Interception was determined by measuring throughfall and stemflow, sampling 18 storms. Regression equations were developed to describe the atmospheric and surface characteristics influencing interception. Gross rainfall was the only independent variable significantly correlated with throughfall. During the dormant season, gross rainfall was also the only independent variable significantly correlated with stemflow. During the growing season, both duration and gross rainfall were significantly correlated with stemflow. Approximately 12% of gross rainfall is intercepted and returned to the atmosphere. While this amount does not appear to be of major hydrologic important it must be recognized that interception and the redistribution of precipitation by vegetation can be an important part of the water budget and could significantly affect water yield. (Moore-IVI)
W85-04578

COMPARISON OF FIELD- AND LABORATORY-MEASURED AND PREDICTED HYDRAULIC PROPERTIES OF A SOIL WITH MACROPORES,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.

W85-04617

STREAM WATER LEVELS AFFECT FIELD WATER TABLES AND CORN YIELDS,
Agricultural Research Service, Florence, SC.
For primary bibliographic entry see Field 2F.
W85-04726

WATER-TABLE CONTRIBUTION TO ALFALFA EVAPOTRANSPIRATION AND YIELDS IN SANDY SOILS,
Agricultural Research Service, Mandan, ND. Northern Great Plains Research Center.
For primary bibliographic entry see Field 2D.
W85-04727

CORN SILAGE RESPONSE TO SUBSURFACE DRAINAGE ON ALLUVIAL SOIL,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W85-04738

STOMATAL RESPONSES TO LEAF WATER POTENTIALS OF DRIP IRRIGATED PEACH (PRUNUS PERSICA),
Tarleton State Univ., Stephenville, TX.
J. F. Punthakey, M. J. McFarland, and J. W. Worthington.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1442-1449, September-October, 1984. 8 Fig, 1 Tab, 46 Ref.

Descriptors: *Drip irrigation, *Leaves, *Water potential, *Stomata, Peach trees, Water stress, Transpiration, Leaf resistance.

This study evaluated the effect of varying levels of water stress on leaf resistance, leaf water potential and transpiration of drip irrigated peach (Prunus persica (L.) Batsch). Leaf resistances were significantly higher for the 1-emitter tree indicating it to be the most severely stressed. Leaf water potential and transpiration rates were also lower in these trees. Leaf resistances decreased exponentially with increasing solar radiation and curvilinearly with increasing vapor deficit. Stomata responded slower in stressed trees. Leaf resistances were lower at leaf water potential above -20 bars and increased at leaf water potential below -21 for the well watered trees. In stressed trees the threshold value was lowered to -25 bars. Leaf resistance and leaf water potential decreased until its threshold value, after which both increased. (Author's abstract)
W85-04746

D/H RATIOS OF SAP IN TREES: IMPLICATIONS FOR WATER SOURCES AND TREE RING D/H RATIOS,
Lamont-Doherty Geological Observatory, Palisades, NY.
J. W. C. White, E. R. Cook, J. R. Lawrence, and W. S. Broecker.
Geochimica et Cosmochimica Acta, Vol. 49, No. 1, p 237-246, January, 1985. 3 Fig, 6 Tab, 18 Ref. NSF grant ATM 83-13954.

Descriptors: *Water sources, *Trees, *Hydrogen isotopes, Deuterium, Rainfall, Seasonal variation, Groundwater, Soil water, Tree rings, Plant physiology, Plant tissues.

The source water for trees with access to groundwater (which includes soil moisture) is a mixture of growing season rain, and groundwater. The relative amounts of growing season rain and groundwater taken up by a tree can be quantified. Trees on sites with insignificant inputs of groundwater and soil moisture have been found. Measurements of D/H ratios of tree sap can be used to determine the source water for a tree. Based on these measurements, trees can be separated into three categories: those which rely solely on summertime rainfalls, those which rely solely on groundwaters, and those which use both water sources. For trees in the last category, D/H ratios of sap can be used to quantify the relative contributions to the tree's source water of summertime rainfalls and groundwaters. These measurements can be used to select trees for ring isotope studies. Single source trees, those which rely solely on summertime rain or groundwaters appear to be the best choices for measuring long records of tree ring D/H ratios. (Baker-IVI)
W85-04758

SENSITIVITY OF STONE FRUIT ROOTSTOCKS TO WATERLOGGING,
Fruit and Food Technology Research Inst., Stellenbosch (South Africa).
P. J. Stassen, and H. J. Vanzyl.
Deciduous Fruit Grower (Cape Town), Vol. 32, No. 7, p 270-271 and 274-275, 1982. 1 Fig, 1 Tab, 10 Ref. (in Afrikaans and English).

Descriptors: *South Africa, *Waterlogging, *Plant growth, Fruit crops, Root zone, Trees, Sensitivity, Soil water.

Die-back of stone fruit trees in particular is a very common phenomenon in the Western Cape area. The two main causes of die-back are bacterial canker and too much groundwater. Seven rootstocks commonly used for growing stone fruits in the Western Cape were subjected to waterlogged conditions to determine their relative sensitivity to waterlogging. Royal and Nemaguard were the most sensitive to waterlogged conditions, followed by Kakamas, Varkperske and Du Plessis. Myrobalan was considerably more resistant to waterlogging and Marianna most resistant of all. Thus Royal and Nemaguard cannot be considered at all as rootstocks on soils where there is any likelihood of waterlogged conditions. Marianna, on account of its shallow root system, is admittedly able to use an uncompacted and well aerated topsoil layer of 20-30 cm well and can perform optimally in a depth of 45 cm. Practices such as ridging may also be applied to improve the effective depth of shallow soil. Apricot rootstock requires a well aerated soil depth of 60 cm and peach rootstock one of 90 cm. Due to its shallow root system Marianna is more sensitive to ineffectual irrigation and malnutrition on deep sandy soils than peach rootstock. (Baker-IVI)
W85-04812

COARSE FRACTION OF SOILS: THE ROLE IT PLAYS IN PLANT NUTRITION, LIMING AND IRRIGATION,
For primary bibliographic entry see Field 2G.
W85-04823

WATER RELATIONS OF JAMAICAN UPPER MONTANE RAIN FOREST TREES,
Washington Univ., St. Louis, MO. Dept. of Biology.
V. Kapos, and E. V. J. Tanner.
Ecology, Vol. 66, No. 1, p 241-250, February, 1985. 6 Fig, 2 Tab, 41 Ref.

Descriptors: *Rain forests, *Plant water potentials, *Jamaica, Leaves, Plant growth, Drought resistance, Leaf temperature, Leaf resistance, Solar radiation, Xeromorphic leaves.

The water relations of an upper montane rain forest at an elevation of about 1550 m in the Blue Mountains of Jamaica were studied to investigate whether the growth of the forest is limited by water shortage and/or whether the characteristically hard, leathery leaves of tropical montane rain forest trees are an adaption to water shortage. Daily courses of leaf water potential, leaf relative water content, leaf resistance, and leaf temperature were followed for nine tree species at the driest time of year. The lowest leaf water potential measured was -1.7 MPa. Leaf resistance was usually low and rarely showed increases that might be attributed to water shortage; it was significantly correlated with light levels. Leaf relative water content was always > 86% and was not correlated with leaf water potential. Leaf sublethal water deficits (SLD) averaged 27% (12 species). There was no relationship between SLD and leaf structural characteristics. Water supply rarely, if ever, seriously limits the growth of these montane forests and their xeromorphic leaves are not an adaptation to water limitation. (Author's abstract)
W85-04824

THROUGHFALL AND STEM FLOW IN MATURE AND YEAR-OLD WET TROPICAL FOREST,
Florida Univ., Gainesville. Dept. of Botany.
J. W. Raich.
Tropical Ecology, Vol. 24, No. 2, p 234-243, Winter, 1983. 2 Fig, 3 Tab, 30 Ref.

Descriptors: *Throughfall, *Stem flow, *Tropical forests, *Costa Rica, Rainfall, Trees, Palm trees, Interception, Succession, Tropical regions, Forests.

Rainfall in the open, throughfall, and stem flow were measured over a six-month period in mature lowland wet forest and a nearby one-year-old successional area of Costa Rica. Throughfall was highly variable both from day to day and from point to point within both sites, but averaged 52% of rainfall in the forest and 68% in the young successional area. Despite the rainy environment, some microsites consistently received no precipitation. Stem flow in the forest averaged 9% of rainfall; 92% of this was collected by palm trees, and > 74% was collected by trees < 10 cm in diameter. Stemflow in the young successional area averaged 4% of rainfall, of which 61% was collected by monocotyledons. Interception of rainfall was greater in the forest than in the successional area by about one-third. The large amount of interception by the one-year-old vegetation is attributed to the rapid development of a high leaf area, and indicates a very rapid functional recovery of the community. (Author's abstract)
W85-04853

WATER AND NUTRIENT OUTFLOW FROM CONTRASTING LODGEPOLE PINE FORESTS IN WYOMING,
Wyoming Univ., Laramie. Dept. of Botany.
D. H. Knight, T. J. Fahey, and S. W. Running.
Ecological Monographs, Vol. 55, No. 1, p 29-48, March, 1985. 13 Fig, 5 Tab, 88 Ref. NSF grants DEB 78-050311, DEB 80-11024 and DEB 81-13546.

Descriptors: *Nutrients, *Water, *Forest hydrology, *Pine trees, *Wyoming, Evapotranspiration, Habitats, Nitrogen, Transpiration, Snowmelt, Water quality, Hydrographs, Succession, Logging.

Factors affecting water and nutrient outflow beyond the rooting zone were studied during a 3 yr period using data from eight contrasting stands of lodgepole pine forest in southeastern Wyoming and the output of a hydrologic simulation model based on tree physiology. Nutrient outflow during a specific time period was estimated by multiplying simulated water outflow times element concentrations in the soil solution, the latter determined from samples collected periodically near the bottom of the rooting zone. The results indicate that stands differing in site or habitat type experience different rates of water and element losses at different times during the snow melt season, and contribute differentially to streamwater quality and hydrograph shape. Factors affecting outflow are discussed in the context of successional trends, common perturbations including timber harvest, and hypotheses pertaining to nutrient conservation in terrestrial ecosystems. Nutrient retention in the snow-dominated lodgepole pine ecosystem appears to be primarily dependent on evergreen leaf area, duration of the vernal transpiration period, and high carbon/nutrient ratios of the forest floor. (Baker-IVI)
W85-04882

EFFECTS OF SOIL WATERLOGGING ON THE ENERGY STATUS AND DISTRIBUTION OF SALIX NIGRA AND S. EXIGUA (SALICACEAE) IN THE ATCHAFALAYA RIVER BASIN OF LOUISIANA,
University of Southwestern Louisiana, Lafayette. Dept. of Biology.

C. P. Dionigi, I. A. Mendelssohn, and V. I. Sullivan.
American Journal of Botany, Vol. 72, No. 1, p 109-119, January, 1985. 5 Fig, 5 Tab, 44 Ref.

Descriptors: *Willows, *Waterlogging, *Atchafalaya River Basin, *Louisiana, Ecological distribution, Plant water potential, Leaves, Flood tolerance, Water stress, Soil-water-plant relationships, Drought tolerance.

The influence of soil waterlogging on the distribution and energy status of Salix nigra and S. exigua were studied in the field and laboratory. Differential flooding in natural stands of Salix spp. and under controlled conditions in the greenhouse demonstrated that S. nigra was more tolerant of waterlogged soil conditions than was S. exigua. Salix nigra exhibited a significantly higher leaf energy status and greater ability to oxidize waterlogged soil when flooded than did S. exigua. However, S. exigua appeared to be more tolerant of moisture stress than S. nigra as indicated by the significantly higher leaf resistances to water vapor exchange and higher leaf water potentials of S. exigua. These data support the theory that the reason S. nigra inhabits lower elevations sites than S. exigua in the Atchafalaya River Basin may be the differential tolerance of these two species to soil waterlogging on one extreme and moisture deficiencies on the other. (Author's abstract)
W85-04943

2J. Erosion and Sedimentation

KINEMATIC STRUCTURE OF FLOW IN A TRAPEZOIDAL CHANNEL,
For primary bibliographic entry see Field 8B.
W85-04421

INVESTIGATION OF THE STABILITY OF RIVER AND CANAL CHANNELS,
I. S. Kuul'.
Hydrotechnical Construction, Vol. 18, No. 3, p 128-132, March, 1984. 6 Fig, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 27-31, March, 1984.

Descriptors: *Channel scour, *Channel erosion, *Channels, *Canals, Stability, *Volga River, *USSR, Hydraulics, River beds, Erosion.

Analysis of hydraulic and hydrologic data from the Volga-Akhtuba floodplain and the Volga delta shows that the rate and extent of channel deformations depend not only on the flow velocity but also on the rate of rise and fall of stages and other factors. The data indicate a decrease of the erosion resistance of the bed depositions after recession of the flood. This is related to a change in the physical, mechanical, and strength properties of the soils during passage of the flood. On the falling limb of the flood, the lifting forces of the turbulent channel flow and vertical component of the buoyant uplift pressure are added to the other forces, as a result of which the channel soils are decompressed and lose their structural strength and erosion resistance. (Keenan-IVI)
W85-04422

CONSIDERATION OF SEDIMENT TRANSPORT WHEN CALCULATING LOCAL SCOUR,
G. A. Arkhipov.
Hydrotechnical Construction, Vol. 18, No. 4, p 149-153, April, 1984. 5 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 14-16, April, 1984.

Descriptors: *Bridges, *Design criteria, *Scour, *Sediment transport, Mathematical equations, Piers, Flow paths, Sediment erosion, Velocity, Currents.

To study the general picture of flow past a cylindrical pier, visual observations were carried out by means of a colored liquid released through a special movable needle attached on the rod of a point gauge. A study of the paths of the flow around the pier shows that in the front of any face on the axis of symmetry the flow is stratified into through-going and descending currents. The descending currents form reversed currents in the form of rollers with a horizontal axis of rotation. The most intense is the bottom roller which scours the bottom in the region of the front part of the pier, forming a scour zone, the boundary of which depends on the velocity of the oncoming flow, width of the pier, and material composing the channel. Scour occurs in the region of the front part of the pier, and the remaining part of the pocket forms due to sliding of the slope of the local scour pocket. The sediment sliding into the scour zone is removed by the bottom currents. The depth of the local scour pocket was calculated by several formulas and results were compared with actual data. A formula was developed which gives satisfactory results, and can be recommended for use when designing bridges. (Baker-IVI)
W85-04427

WATERSHED REHABILITATION PROGRAM RELATED TO THE MANAGEMENT OF RIVER AND RESERVOIR SEDIMENTATION IN INDONESIA,
Ministry of Forestry, Djakarta (Indonesia).
For primary bibliographic entry see Field 4D.
W85-04438

RESERVOIR SEDIMENTATION IN INDIA – ITS CAUSES, CONTROL, AND FUTURE COURSE OF ACTION,
Land Use Consultants (International), New Delhi (India).
For primary bibliographic entry see Field 6G.
W85-04439

MANAGMENT OF SEDIMENTATION IN BANGLADESH,
Bangladesh Water Development Board, Dacca.
G. R. Choudhury.
Water International, Vol. 9, No. 4, p 155-157, December, 1984.

Descriptors: *Sedimentation, *Bangladesh, *Management, Floods, Bay of Bengal, Ganges River, Brahmaputra River, Meghna River, Channel migration.

Bangladesh lies in the southeast corner of the south Asian subcontinent, having an area of 144000 sq km and has within her territory the confluence of the three great river systems - the Ganges, the Brahmaputra and the Meghna. Each year during the flood season the waters overtop the banks and flood some 30% of the total land area of Bangladesh. The country being flat, the horizontal and vertical tides from the Bay of Bengal penetrate far inland. Past and present changes of hydrological setting are reviewed. The sediment movement process in Bangladesh is studied from the following aspects: sedimentation as a channel process, bank caving and channel migration, sedimentation and its effect on distributaries, and sedimentation in the tidal flood plains. (Baker-IVI)
W85-04440

SEDIMENTATION IN NEW ZEALAND HYDROELECTRIC SCHEMES,
Ministry of Works and Development, Wellington (New Zealand).
I. Jowett.
Water International, Vol. 9, No. 4, p 172-176, December, 1984. 1 Fig, 1 Tab, 14 Ref.

Descriptors: *Sedimentation, *New Zealand, *Hydroelectric projects, Erosion control, Reservoir storage, Reservoir sedimentation, Sediment management.

Sedimentation of New Zealand hydroelectric reservoirs has not been a great problem mainly because development has concentrated on rivers where a large proportion of the sediment is trapped by large upstream lakes. Catchments of major schemes have yielded less than 200 t/sq km of sediment annually. Smaller schemes have encountered problems when catchment sediment yields approach 2000 t/sq km/yr and fortunately no schemes have been built on the few New Zealand catchments eroding at rates approaching 20,000 t/sq km/yr. The annual cost of regaining reservoir storage lost through sedimentation can be high. The cost of maintaining reservoir intakes free of sediment is not so high as low level sluices of reasonable discharge capacity are installed and used to pass sediment during floods. The extra costs incurred are for abrasion resistant linings and the cost difference between sluice and alternative spillway designs. Environmentally the effects of sediment on the management of reservoirs have not been great. Sluicing of sediment from reservoirs or settling basins creates a problem for recreational users and benthic invertebrates but both recover quickly. Planning for and management of sediment is a long-term problem. (Baker-IVI)
W85-04445

SEDIMENT STORAGE AND TERRACE FORMATION IN COYOTE GULCH BASIN, SOUTH-CENTRAL UTAH,
California Univ., Santa Cruz. Dept. of Earth Sciences.
P. J. Boison, and P. C. Patton.
Geology, Vol. 13, No. 1, p 31-34, January, 1985. 4 Fig, 17 Ref. NSF grants EAR 77-23025, EAR 81-00391 and EAR 81-19981.

Descriptors: *Coyote Gulch, *Utah, *Sediment storage, *Terraces, Alluvial deposits, Stratigraphy, Fluvial sediments, Sedimentation, Streams, River basins.

Coyote Gulch and its major tributaries, Big Hollow Wash, Hurrican Wash, and Dry Fork, drain an area of 373 sq km on the western side of the Escalante River basin. The basin is characterized by high gradient ephemeral stream channels and slopes ranging from 0.005 to 0.018 m/m. Runoff occurs during the spring from snowmelt on the Kaiparowits Plateau and during the summer and fall from high-intensity localized thunderstorms. The stratigraphic data from the Coyote Gulch drainage document rapid aggradation of a stream system resulting from sediment loading in the headwaters of a drainage. This large volume of sediment was subsequently incised, creating in the process two terraces in upper Coyote Gulch and as many as three terraces in Dry Fork. The terraces differ in number, morphology and sedimentology, depending on their location within the drainage network. Aggradation began about 2300 B.P. and lasted for about 1300 yr. The major period of aggradation in the Dry Fork was not continuous but was interrupted by incision, presumably when a higher gradient sand-transporting stream was established across this fill. Beginning about 900 B.P. this alluvium was incised, creating two terraces in upper Coyote Gulch which eventually incised to form a single terrace. Rapid sediment loading thus produced different fluvial responses depending on the location of a channel segment in the drainage network. Such studies can provide insight into the magnitude and rate of sediment storage in stream valleys as well as the timing and processes by which sediment is ultimately transported out of a basin. (Baker-IVI)
W85-04646

SEDIMENTOLOGY AND GEOCHEMISTRY OF MODERN SEDIMENTS IN THE KINGSTON BASIN OF LAKE ONTARIO,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 2H.
W85-04714

RANGELAND EROSION MEASUREMENTS FOR THE USLE,
Agricultural Research Service, Boise, ID. Northwest Watershed Research Center.
C. W. Johnson, M. R. Savabi, and S. A. Loomis.
Transactions of the American Society of Agricultural Engineers, p 1313-1320, 1984. 2 Fig, 7 Tab, 29 Ref.

Descriptors: *Erosion, *Rangeland, *Idaho, *Nevada, *Erodibility, Simulated rainfall, Sagebrush, Shadscale, Range management.

A rotating-boom rainfall simulator was used on sagebrush and shadscale rangeland sites in southwest Idaho and north-central Nevada to obtain USLE soil erodibility, K, and cover-management, C, factor values. A good relationship, r squared = 0.89, was obtained between measured soil loss from tilled simulator plots at four different sites and predicted soil loss using the USLE soil erodibility nomograph. However, relationships between soil loss predictions using a cover-management subfactor procedure and soil loss measurements using the rainfall simulator were in poor agreement, r squared = 0.27, for all vegetated plots combined. Soil loss from simulation on plots ungrazed for ten years was consistently less than predicted, and plots on one site clipped of all standing vegetation produced more soil loss than predicted. Thus, the variability in predicted soil losses from sagebrush rangelands indicates a need for more accurate quantification of cover and management conditions. (Author's abstract)
W85-04728

PERFORMANCE OF GRASS FILTERS UNDER LABORATORY AND FIELD CONDITIONS,
Mississippi State Univ., Mississippi State. Dept. of Agricultural and Biological Engineering.
J. C. Hayes, B. J. Barfield, and R. I. Barnhisel.
Transactions of the American Society of Agricultural Engineers, p 1321-1331, 1984. 8 Fig, 6 Tab, 17 Ref, 1 Append.

Descriptors: *Erosion, *Sediment transport, *Runoff, *Model studies, *Grasslands, *Filtration, Sediment trapping, Deposition, Particle size.

A design model was demonstrated that estimates the filter effectiveness of grass subjected to sediment-laden runoff. A number of laboratory and field studies indicate that this model possesses the capability of serving as a working tool for estimating the fraction of sediment trapped and outflow concentration as a function of inflow hydraulic and sediment conditions. Additional necessary inputs for the model include the dimensions of the filter and vegetation. Analysis of complex situations, such as where either the channel slope or grass characteristics change along the filter length, is possible. An additional feature of the model is the capability to recalculate particle size distribution as a function of the sediment trapped in the filter. The developed relationships include the terms which would be anticipated to play an important role in filter phenomenon. Evaluation of the model based on verification studies using real grasses in laboratory flumes and in outdoor channels is described. The results from each set of tests indicated that more than 94% of the inflow sediment load was typically accounted for by this design. (Author's abstract)
W85-04729

CHEMICAL FLOCCULATION FOR SUSPENDED SOLIDS REMOVAL AT REMOTE MINE SITES,
Commonwealth Technology, Inc., Lexington, KY.
For primary bibliographic entry see Field 5D.
W85-04730

SEDIMENT DETENTION POND MODEL USING CSTRS MIXING THEORY,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5E.
W85-04731

PREDICTION OF SOIL EROSION BY WATER AND WIND FOR VARIOUS FRACTIONS OF COVER,
Missouri Univ.-Columbia. Dept. of Agricultural Engineering.
J. M. Gregory.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1345-1350 and 1354, September/October 1984. 5 Fig, 26 Ref.

Descriptors: *Soil erosion, *Wind erosion, *Rain, *Residue cover, *Crop canopies, Prediction, Mathematical equations.

Crop canopies and residues provide cover that reduces soil loss by water and wind erosion. An attempt is made to provide a model to explain how residue cover reduces soil detachment by raindrops and wind. Four concepts were used to develop equations to predict relative soil loss as a function of residue and canopy cover. Reductions in soil erosion due to canopy, residue and standing water were predicted based on the reduction in kinetic energy reaching the soil. Equations were derived for the effect of canopy and residue and for cover by standing water. The equations were combined into one equation to predict rates of soil loss relative to bare soil conditions. Comparisons were made between predictions and measured data reported in the literature. The final equations for erosion by water and wind are very similar and relatively easy to use. Both should be useful in evaluating the reduction in soil loss by canopy and residue cover. (Baker-IVI)
W85-04732

METHOD OF MEASURING AGGREGATE STABILITY UNDER WATERDROP IMPACT,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
R. A. Young.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1351-1354, 1984. 2 Fig, 1 Tab, 23 Ref.

Descriptors: *Soil erosion, *Rain, *Aggregate stability, Rill erosion, Interrill erosion, Soil properties, Clay, Organic matter, Sediment yield, Erodibility.

Soil erosion is the end result of two physical processes - the detachment of soil particles from a soil mass and the transport of these particles away from the point of detachment. A laboratory method has been developed to characterize the susceptibility of a soil to rill or interrill erosion. Tests showed the effectiveness of this measurement as an index of type or erodibility. The presence of high organic matter and high clay content have been inversely related to the susceptibiliy of soil to rill erosion and interrill erosion, respectively. Crofton silt loam, which is a loess soil with only 0.5% organic matter but relatively high clay content, had the smallest mean weight diameter of the five soils after wet sieving alone, indicating that it was the least stable soil when subjected to slaking. It was relatively stable under drop impact forces. Barnes loam had almost 6% organic matter, but less clay than Crofton. Barnes loam, under natural rainfall conditions, forms very few significant rills and most of the detached soil originates in the interrill area. Crofton silt loam is characterized by severe rilling even under moderate rainfall. Once the ratio of interrill erosion to rill erosion is known, it can be used to partition the rill and interrill erodibility factors in current erosion and sediment yield equations more accurately. (Baker-IVI)
W85-04733

RUNOFF AND SEDIMENT TRANSPORT WITHIN AND FROM SMALL AGRICULTURAL WATERSHEDS,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
J. M. Hamlett, J. L. Baker, S. C. Kimes, and H. P. Johnson.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1355-1363 and 1369, September-October, 1984. 3 Fig, 4 Tab, 22 Ref.

Descriptors: *Sediment transport, *Agricultural runoff, *Runoff, *Iowa, Precipitation distribution, Tillage, Soybeans, Corn, Moldboard plowing, Disking, Rainfall-runoff relationships, Cultivation.

Precipitation, runoff, and sediment loads for six nested watersheds in a heavily row-cropped region in east-central Iowa were investigated. Spatial and temporal variations in precipitation were substantial. The watershed with the more intensive and/or most recent tillage had the least runoff except during severe events when rainfall-runoff amounts from the smaller, field-sized watersheds were nearly identical. The peak suspended-sediment concentrations preceded or occurred simultaneously with peak runoff rates. The storm-weighted sediment concentrations were generally greater for the watershed in soybeans which was moldboard plowed than for the watershed in corn which was disked. However, annual sediment loss was greater from the corn watershed than from the soybean watershed, except during severe storms when rainfall-runoff was comparable. The permanent pasture had neglible runoff and sediment losses. Sediment load decreased when comparing the field, intrabasin, and stream locations. Sediment deposition in pondage areas was often substantial. (Author's abstract)
W85-04734

HYDROLOGY AND SEDIMENTOLOGY WATERSHED MODEL. PART I: OPERATIONAL FORMAT AND HYDROLOGIC COMPONENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W85-04735

HYDROLOGY AND SEDIMENTOLOGY WATERSHED MODEL. PART II: SEDIMENTOLOGY COMPONENT,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2A.
W85-04736

TILLAGE INFLUENCES ON EROSION DURING FURROW IRRIGATION,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4C.
W85-04749

COMPOSITION AND POSSIBLE ORIGIN OF DETRITAL MATERIAL IN STREAMS,
Oregon State Univ., Corvallis. Dept. of Forest Science.
P. Sollins, C. A. Glassman, and C. N. Dahn.
Ecology, Vol. 66, No. 1, p 297-299, February, 1985. 1 Tab, 14 Ref. NSF grant DEB 81-12455.

Descriptors: *Detritus, *Stream sediments, *Chemical composition, Oregon, Organic matter, Particulate matter, Density, Floodplains, Wood, Leaves, Soil, Carbon, Nitrogen, Aluminum, Iron, Manganese.

Stream detritus consists in part of fragmented plant material, microbial biomass and by-products, and precipitated dissolved organic material. Streams, however, also transport and store mineral-soil particles on which large amounts of organic matter are already adsorbed when the particles enter the stream. Density fractionation is used to provide initial data on the composition of detritus from several small streams in Oregon. Density and chemistry of the stream and floodplain detritus are compared with those of materials that might serve as a source for the detritus: soil from the forest adjacent to the floodplain and submerged waterlogged wood and foliage. Most of the foliage (91%) and submerged wood (99%) was light material (F1 and F2). Every toe-slope soil sample contained >60%of its dry mass in the heaviest fraction (F3), which accounted for 30-80% of the total soil C and 40-85% of the total soil N. Floodplain and pool samples collected by excavation contained nearly all of their dry mass in the heaviest fraction (F3). The heaviest fraction also accounted for most of the C and N in all pool sediment samples. Al, Fe, and Mn concentrations in stream-channel and floodplain F1 and F2 fractions ranged from 0.9 to 2.2% for Al, 0.5 to 4.1% for Fe, and 0.017 to 0.11% for Mn. (Moore-IVI)
W85-04827

CONTRAST IN STREAM-CHANNEL RESPONSE TO MAJOR STORMS IN TWO MOUNTAINOUS AREAS OF CALIFORNIA,
Geological Survey, Menlo Park, CA.
K. M. Nolan, and D. C. Marron.
Geology, Vol. 13, No. 2, p 135-138, February, 1985. 3 Fig, 1 Tab, 31 Ref.

Descriptors: *Storms, *Channel geometry, *California, Mountain streams, Sediment transport, Landslides, Floods, Sediment erosion.

The effects of major storms on the geometry of intermediate- and high-order channels in northwestern California is contrasted with channel changes found in the Santa Cruz Mountains. Northwestern California was subjected to major regional storms in December 1964, December 1972, and March 1975. There was pervasive, long-lasting widening and filling of intermediate- and high order channels as a result of these storms. The Santa Cruz Mountains were subjected to a major flood-producing storm in January 1982. Although the storm was responsible for widespread flooding and damage to man-made features, major channel changes were found only in localized areas after the storm. Sediment delivery in northwestern California during storms overwhelms transport capacities throughout the length of the most intermediate- and high-order channels and causes long-lasting changes in geometry. Sediment delivery during storms in the Santa Cruz Mountains overwhelms transport capacities only in localized reaches. This contrast in channel behavior is at least partially caused by contrasts in the style of landsliding found in the two areas. In northwestern California, a positive feedback loop may exist between hillslope and stream-channel processes. (Moore-IVI)
W85-04836

COMPUTING DEGRADATION AND LOCAL SCOUR,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
E. L. Pemberton, and J. M. Lara.
Available from the National Technical Information Service, Springfield, VA 22161. Technical Guideline, January 1984. 48 p, 12 Fig, 10 Tab, 45 Ref.

Descriptors: *Channel erosion, *Channel scour, *Scour, *Slope degradation, *Model studies, Flow measurement, Streambeds, Flow velocity, Mathematical models, Channel flow, Channel improvement, Erosion, Stream stabilization, Theoretical analysis, Channels, Flood channels, Slope stability.

These guidelines describe methods for computing general river channel degradation and local scour during peak floodflows for use in designing reclamation structures. The Meyer-Peter and Muller, competent bottom velocity, Lane's tractive force, Shields diagram, Yang incipient motion, and depth to armor and volume computation models are used to calculate degradation limited by armoring. The Schoklitsch, Meyer-Peter and Muller, Shields diagram, Lane's tractive force and stable slope and volume computation methods are used to describe degradation limited by a stable slope. Recommendation of a specific method for predicting channel degradation or local scour is difficult because of the complexity and variability of the many factors affecting the erosive action of the channel. It is suggested that several methods be tried before selecting the techniques to be used based upon engineering experience. Descriptions of appropriate bed sampling techniques are included to ensure accuracy in the collection of field data used in the analytical equations.
W85-04934

2K. Chemical Processes

DELTA 13C MEASUREMENTS AS INDICATORS OF CARBON FLOW IN MARINE AND FRESHWATER ECOSYSTEMS,
Indiana Univ. at Bloomington. Dept. of Biology.
B. Fry, and E. B. Sherr.
Contributions in Marine Science, Vol. 27, p 13-47, September, 1984. 4 Fig, 5 Tab, 187 Ref. NASA grant NGR 15-003-118, NSF grant PCM 7910747.

Descriptors: *Carbon radioisotopes, *Marine environment, *Ecosystems, Food chains, Organic carbon, Sediments, Particulate matter, Organic matter, Trophic level, Estuarine environment, Plants, Microorganisms.

Stable carbon isotopic measurements provide useful information about which autotrophs are important sources of carbon in marine and freshwater sediments, particulate organic carbon (POC), and food webs. Transect studies of sediments and POC often show clear-cut patterns of isotopic change that can be directly related to the proximity of various carbon sources; this has led to the use of simple mixing models to indicate the relative importances of plant carbon sources. Isotopic interpretations of delta C-13 data are not always easily made. Potential complications include isotopic changes during plant decomposition and multiple sources of organic matter. Isotopic measurements are particularly valuable in food web studies. Offshore studies of entire natural food webs uniformly indicate a cumulative increase in C-13 with increasing trophic level. Two major ideas have emerged from the use of stable isotope analyses in estuaries: photosynthesis by aquatic microorganisms is often the major source of organic carbon for estuarine POC and sediments; and food webs in salt marshes and seagrass meadows are not uniformly based on detrital macrophytes, but on algae in some locations. Combined with other isotopic and geochemical techniques, stable carbon isotope analysis can provide definitive answers to questions of the origin of fixed carbon in aquatic ecosystems. (Moore-IVI)
W85-04431

GEOCHEMISTRY OF INORGANIC GERMANIUM IN NATURAL WATERS,
Florida State Univ., Tallahassee. Dept. of Oceanography.
P. N. Froelich, G. A. Hambrick, M. O. Andreae, and R. A. Mortlock.
Journal of Geophysical Research, Vol. 90, No. C1, p 1133-1141, January, 1985. 5 Fig, 4 Tab, 56 Ref.

Descriptors: *Germanium, *Silicon, *Geochemistry, *Path of pollutants, Water pollution sources, Granite, Basalt, Spatial distribution.

The distribution of dissolved inorganic germanium in rivers, in the oceans, and in hydrothermal vents and plumes was surveyed. In the ocean, germanium cycling mimics that of silica, since siliceous organisms incorporate Ge as a trace constituent in biogenic opal. The vertical and horizontal distributions of Ge concentrations in seawater are thus identical to those of silica (Ge/Si approximately 0.0000007) and reflect uptake into and dissolution from the frustules of siliceous organisms. Germanium enters the ocean via dissolution of continental and seafloor silicates. The naturally weathered flux from continents to oceans carries a dissolved Ge/Si atom ratio in rivers of about 0.0000007 which reflects the ratio in average continental granites. Rivers draining industrial regions with significant coal combustion are contaminated with Ge leached from fly ash particles, resulting in Ge/Si ratios up to tenfold above the naturally weathered background. The flux to the oceans via high-temperature alteration of seafloor basalts (hot springs) produces a Ge anomaly in hydrothermal plumes over the East Pacific Rise (EPR) crest (20 degrees S). Combining the observed Ge and He-3 anomalies in plumes with He-3/Si observations in hot springs suggests that the Ge/Si hydrothermal flux to the oceans is about 0.000004, near the ratio for average oceanic basalts (approximately 0.0000026). Vent effluents from the Galapagos hot springs measured directly display Ge/Si ratios of 0.000016, suggesting that the ratio is variable between vent fields. Metalliferous sediments accumulating on the EPR crest (17 degrees S) are enriched in germanium, suggesting that a fraction of the hydrothermal germanium source on the rise crest is scavenged into these rapidly accumulating iron and manganese hydroxyoxide phases. (Author's abstract)
W85-04482

LOOSDRECHT LAKES RESTORATION PROJECT: SEDIMENT PHOSPHORUS DISTRIBUTION AND RELEASE FROM THE SEDIMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
P. C. M. Boers, J. W. T. Bongers, A. G. Wisselo, and T. E. Cappenberg.
Verhandlung Internationale Vereinigung Limnology, Vol. 22, p 842-847, October, 1984. 2 Fig, 4 Tab, 11 Ref.

Descriptors: *Loosdrecht Lakes, *Netherlands, *Lake sediments, *Phosphorus, *Sediment-water interface, Lake restoration, Lakes, Chemical properties, Sediments, Nutrients.

The Loosdrecht Lakes are situated in the center of the Netherlands and are man-created by peat excavation. The lakes are highly eutrophic, with chlorophyll a maxima up to 320 mg/cu m. The main source of pollution of the lakes is a high external P loading, mainly from the river Vecht. The distribution of P in the Loosdrecht Lakes sediment is described together with results of experiments of chemical properties, release rates from sediments and availability for autotrophic growth of this P. At most sampling stations the lower layers of the bottom consist of firm peat, covered by variable amounts of very loose brown mud, accumulating at sheltered places. Chemical extractions proved unsuitable to determine bio-available P. The experimental evidence, collected so far, suggests that in spring considerable amounts of P are released from the Loosdrecht Lakes sediment. It is as yet impossible to estimate the effects of this release on the ecosystem. (Baker-IVI)
W85-04546

SIZE CLASSES OF 'DISSOLVED' NUTRIENTS IN SHALLOW, ALKALINE, HUMIC AND EUTROPHIC TJEUKEMEER, THE NETHERLANDS, AS FRACTIONATED BY ULTRAFILTRATION,
Limnologisch Inst., Oosterzee (Netherlands). Tjeukemeer Lab.
H. De Haan, T. De Boer, J. Voerman, H. A. Kramer, and J. R. Moed.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 876-881, October, 1984. 4 Fig, 13 Ref.

Descriptors: *Limnology, *Lakes, *Lake Tjeukemeer, *Netherlands, *Nutrients, Chlorides, Ultrafiltration, Eutrophic lakes, Seasonal variation, Dissolved solids, Silicon, Iron, Phosphorus, Carbon, Nitrogen.

Ionic species are recognized to be the most available form of nutrients. To get an impression of the seasonal size class distribution of dissolved major elements and algal nutrients, Tjeukemeer water was subjected to ultrafiltration using filters of 200-5 nm nominal pore size. Fluorescence, UV absorbance and dissolved organic carbon were included in the study as Tjeukemeer is rich in metal chelating fulvic acids. The total dissolved concentrations of the parameters analyzed fluctuated seasonally and were either positively or negatively related with the chloride ion concentration, and hence with the hydrology of the lake. Throughout the sampling period all Si occurred in the smallest size class, and hence, in solution. In contrast most of the Fe and P was found in the two largest size classes. Especially the largest size class of these two elements was abundant in winter when the lake received humic polder water. This class contained little organic C and exhibited no fluorescence, suggesting that the colloidal Fe and P consisted of Fe(III)-hydroxide-phosphates which might have been peptized by the organic C. Additional evidence of the mainly inorganic nature of these colloids lies in their acid-lability. Concentrations of colloidal N fractions were highest in winter and corresponded with relatively high concentrations of colloidal organic C fractions. This suggests the occurrence of proteinaceous material. (Baker-IVI)
W85-04550

AVAILABILITY OF SEDIMENT P IN LAKE LUGANO,
Commission of the European Communities, Ispra

(Italy).
For primary bibliographic entry see Field 2H.
W85-04563

NUTRIENT PROCESSING IN AMAZON FLOODPLAIN LAKES,
Washington Univ., Seattle. Inst. for Environmental Studies.
B. R. Forsberg.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1294-1298, October, 1984. 3 Fig, 1 Tab, 11 Ref. NSF grant BSR-8003203.

Descriptors: *Nutrients, *Lakes, *Amazon floodplain, *Brazil, Chemical properties, Seasonal variation, Limiting nutrients, Phytoplankton, Macrophytes, Nitrogen.

An analysis of nutrient chemistry was made in two Amazon floodplain lakes and their tributaries. Preliminary bioassay experiments have indicated that the phytoplankton in these lakes is limited by different nutrients. Because a different pattern of nutrient dynamics is expected in each case, the results should provide a critical test of the assumptions involved in the analysis and additional support for the bioassay conclusions. Water samples were collected at biweekly intervals during the period February 1981 to February 1982. In each lake only one of the two major nutrients was significantly processed - that nutrient which had been indicated as the growth limiting nutrient in previous bioassay experiments. The high levels of dissolved organic nitrogen in the open water region may reflect the dominance of macrophytes in this system. Because the lake is highly turbid when river water is entering, the phytoplankton is unable to take advantage of the input of inorganic nitrogen. Most of these nutrients are apparently taken up by the floating macrophytes. Once incorporated into the macrophyte tissue, N would only be recycled to the open water either through excretion or decomposition which appears to occur on an annual basis in other white water lakes. In either case, the N would most likely be released in a dissolved organic form. A great deal can be learned about the pattern of nutrient limitation and dynamics in floodplain lakes by examining the nutrient chemistry in the lakes and their tributaries. (Baker-IVI)
W85-04571

SENSITIVITY ANALYSIS OF RESERVOIR OXYGEN MODEL,
McMaster Univ., Hamilton (Ontario). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 2H.
W85-04585

INORGANIC NUTRIENTS OCCURRING IN THE OXYGEN-DEFICIENT BOTTOM WATER OF OSAKA BAY,
Osaka Prefecture Fisheries Experimental Station (Japan).
H. Joh, S. Yamochi, T. Abe, and A. Kawai.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No. 10, p 1693-1700, October, 1984. 10 Fig, 1 Tab, 15 Ref.

Descriptors: *Nutrients, *Dissolved oxygen, *Osaka Bay, *Japan, Phosphorus, Nitrogen, Apparent oxygen utilization, Inorganic compounds, Sediments, Decomposition, Bays.

In summer, oxygen-deficient layer is being formed extensively in the waters of the lower strata of Osaka Bay, from the interior to the east part of the bay. A large amount of inorganic nutrients are found in such lower waters. Based on the accumulated data obtained from 1972 to 1982, a remarkable regularity was observed as to the concentrations of inorganic nutrients and dissolved oxygen (DO) in the water. Plots of dissolved inorganic phosphorus (DIP) versus apparent oxygen utilization (AOU) are approximately on two straight lines with an intersection at AOU ca. 2-4 ml/l, whereas dissolved inorganic nitrogen (DIN) is plotted versus AOU on a single straight line. However the abundance ratio of DIN in oxidized forms (NO2-N + NOs-N) decreases with the increase of AOU in the lower waters with AOU above ca. 4 ml/l. It may be concluded that the generation of DIP and DIN in the decomposition process of organic materials accompanies the DO consumption at a definite rate in oxic waters. In the oxygen-deficient lower waters, DIP increases in its concentration by the liberation from the lower sediments, and DIN remains in the reduced form (NH4-N) by the suppressed oxidation process. (Author's abstract)
W85-04606

PHOSPHORUS IN THE BOTTOM SEDIMENTS OF SOME LAKES OF THE WORLD,
Akademia Rolnicza, Wroclaw (Poland). Dept. of Limnology.
For primary bibliographic entry see Field 2H.
W85-04612

PHOSPHATASES AND THEIR ROLE IN ORGANIC PHOSPHORUS TRANSFORMATION IN NATURAL WATERS. A REVIEW,
Warsaw Univ. (Poland). Dept. of Environmental Microbiology.
W. Siuda.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 3, p 207-233, 1984. 10 Fig, 6 Tab, 91 Ref.

Descriptors: *Phosphatases, *Phosphorus compounds, *Microorganisms, Plankton, Enzymes, Natural waters, Lakes, Cycling nutrients, Organic compounds, Mineralization.

Both autotrophic and heterotrophic aquatic microorganisms produce alkaline and acid phosphatases. In the photic zone of lakes, adaptive alkaline phosphatases dependent on phosphate concentration are produced by the phytoplankton. In profundal waters constitutive acid phosphatases are mainly produced by microheterotrophs. These enzymes are independent of phosphate. Studies of the physical, chemical and biological factors which influence the activity of plankton phosphatases are important for understanding of the role of these enzymes in phosphorus cycling in aquatic environments. The ecological significance of phosphatases for mineralization of organic phosphorus compounds in waters is also discussed. (Author's abstract)
W85-04613

PRECONCENTRATION OF SUBMICROGRAM AMOUNTS OF METALS FROM NATURAL WATERS FOR X-RAY ENERGY SPECTROMETRIC DETERMINATION USING PYRROLIDINECARBODITHIOIC ACID,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 5A.
W85-04621

ION CHROMATOGRAPHIC DETERMINATION OF SILICIC ACID IN NATURAL WATER,
Kyoto Univ. (Japan). Dept. of Chemistry.
T. Okada, and T. Kuwamoto.
Analytical Chemistry, Vol. 57, No. 1, p 258-262, January, 1985. 8 Fig, 4 Tab, 25 Ref. Japanese Ministry of Education, Science and Culture grant 58470029.

Descriptors: *Ion chromatography, *Silicic acid, Natural waters, Water analysis, Chemical analysis.

A nonsuppressed ion chromatography using potassium hydroxide solution as an eluent was applied to the determination of silicic acid in natural water (lake water, river water, and tap water). Some anions eluted rapidly, such as fluoride ion and low molecular organic acids, were separated from silicic acid at the eluent concentration of < 1 mM. Fluoride, magnesium, and calcium loss depressed the peak of silicic acid but the other ions did not. However, the interference of fluoride ion was eliminated by adding boric acid into a sample solution and those of magnesium and calcium ions were reduced by the pretreatment with a H(+)-form strong acidic cation-exchange resin. The detection limit was 22 ppb (as Si) and was satisfactory compared with the other methods. The results obtained by this method agreed with those obtained by molybdenum blue method. (Author's abstract)
W85-04623

MULTISTAGE MODEL FOR THE DEVELOPMENT OF HYDROCHEMICAL ZONATION IN CHALK GROUND WATERS,
Toronto Univ. (Ontario). Dept. of Geology.
K. W. F. Howard.
Ground Water, Vol. 23, No. 1, p 4-16, January-February, 1985. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Cretaceous Chalk aquifer, *England, *Groundwater, *Chemical properties, Calcium bicarbonate, Calcite, Sulfates, Saline waters, Geochemistry, Groundwater movement.

Ground waters from the Cretaceous Chalk of east-central England display hydrochemical zonation comprising four water types. These are, in the general direction of ground-water flow: Type I - calcium bicarbonate ($CaHCO_3$) waters undersaturated with respect to calcite, Type II - $CaHCO_3$ waters saturated with respect to calcite, Type III - waters showing sulfate (SO_4) reduction and softening by ion exchange, and Type IV - saline waters. At first appearance these water types may be interpreted as related members in the classically recognized, long-term sequence of natural chemical evolution of subsurface waters. This simple model, however, cannot be reconciled fully with all aspects of the hydrochemistry. For example, there is no satisfactory process that could explain an apparent depletion of chloride when moving from Type I to Type II waters, and transitional boundaries are absent between water Types II and III, and types III and IV. Furthermore, the model lacks credibility in an area where recent geological events have radically disturbed the regional ground-water flow regime. An alternative hydro-chemical zonation model is proposed in which each water type evolves independently of adjacent water types as a function of its own unique aquifer flow history. This multi-stage model is supported by tritium and radiocarbon evidence and can be related to probable changes in the regional flow regime during the past 125,000 years. (Author's abstract)
W85-04634

DISTRIBUTION OF CARBONATES, BICARBONATES, AND PH VALUES IN GROUND WATER OF THE NILE DELTA REGION, EGYPT,
Cairo Univ., Giza (Egypt). Dept of Chemistry.
M. F. M. El Ghandour, J. B. Khalil, and S. A. Atta.
Ground Water, Vol. 23, No. 1, p 35-41, January-February, 1985. 11 Fig, 6 Ref.

Descriptors: *Groundwater, *Carbonates, *Hydrogen ion concentration, *Egypt, Water quality, Bicarbonates, Carbon dioxide, Salinity, Water temperature, Lithology.

Water quality data were obtained from 114 wells in the Nile Delta region and its fringes. The wells were installed to depths varying from 25 to 120 m. Carbonate ions are present in the groundwater of the Nile Delta region in very small amounts (0-96 ppm). These ions decrease or may be absent in the northern parts of the Delta. The bicarbonate contents range between 0 and 738 ppm, depending on the amount of CO_2 in water and following nearly the same trend as that of the carbonates. The variation in pH values with relation to salinity content is quite clear, as water with pH values ranging from 5.5 to 6.9 was found in wells which with a very high salinity (10,000 to 56,000 ppm). This confirms that the increase of salinity content in the northern parts of the Nile Delta leads to a reduction in the pH values, and the decrease of salinity in the southern parts gives a rapid rise in pH. The pH value is a very important indication of groundwater quality in the Nile Delta. The pH values are controlled by the dissolved CO_2, carbonate, bicarbonate, and salinity content. the concentration and distribution of carbonate and bicarbonate contents in the area are mainly dependent on CO_2 pressure, pH value, temperature, and salin-

ity content. The anomaly in ion concentrations in some localities may be related to the variation in the lithological characteristics of the aquifer strata at these localities. (Moore-IVI)
W85-04638

SPATIAL DISTRIBUTIONS OF PRECIPITATION ACIDITY AND MAJOR ION WET DEPOSITION IN NORTH AMERICA DURING 1980,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 5B.
W85-04647

ARSENIC SPECIATION IN SOIL-PORE WATERS FROM MINERALIZED AND UNMINERALIZED AREAS OF SOUTH-WEST ENGLAND,
Thames Polytechnic, London (England).
S. J. Haswell, P. O'Neill, and K. C. C. Bancroft.
Talanta, Vol. 32, No. 1, p 69-72, January, 1985. 3 Fig, 1 Tab, 16 Ref.

Descriptors: *Arsenic, *Interstitial water, *England, *Mineralization, *Fate of pollutants, Soil contamination, Soil water, Aerobic conditions, Anaerobic conditions, Chemical analysis, Arsenite, Arsenate, Monomethylarsonic acid, Microorganisms, Chromatography.

The concentrations of arsenic species were determined in south-west England soil-pore water samples extracted from aerobic mineralized soil (from the Dartington and Trusham soil series) and from water-logged anaerobic unmineralized soil (from the Conway, and Yeolland Park soil series). Arsenate, arsenite and monomethylarsonic acid (MMAA) were characterized using a method based on HPLC anion-exchange chromatography with post-column continuous hydride-generation, followed by atomic-adsorption measurement. The method takes four minutes for a single analysis and gives enhanced detection limits by the use of a preconcentration column. The dominant arsenic species in aerobic soils was arsenate (approximately 90%) with small quantities of arsenite and MMAA in mineralized areas. In anaerobic soils arsenite was found to be the major soluble species. Chemical conditions in aerobic and anaerobic environments suggest that the arsenite levels will be increased in the latter owing to the chemical reducing conditions. At the negative redox potential found in anaerobic soils chemical reduction will override the microbial conversion of arsenate into arsenite. Though reduction of arsenate to arsenite is predominantly a chemically controlled reaction in both anaerobic and aerobic soils, methylation of arsenite to MMAA may be considered to be controlled by microorganisms. No clear relationship between the arsenite, arsenate, and MMAA levels is apparent from the results. As the MMAA levels increase, the levels of arsenite decrease, which may suggest that production of MMAA affects the residual arsenite levels in the soil. Chemical conversion of arsenate into arsenite may preclude microbial activity, thus reducing the production of MMAA. (Collier-IVI)
W85-04662

RADIUM VARIABILITY PRODUCED BY SHELF-WATER TRANSPORT AND MIXING IN THE WESTERN GULF OF MEXICO,
Oregon State Univ., Corvallis. School of Oceanography.
D. F. Reid.
Deep-Sea Research, Vol. 31, No. 12, p 1501-1510, 1984. 6 Fig, 4 Tab, 10 Ref.

Descriptors: *Coastal waters, *Radium radioisotopes, *Caribbean Sea, *Gulf of Mexico, Salinity, Water temperature, Radioisotopes, Path of pollutants, Water pollution sources.

Ra-226 and Ra-228 exhibit significant temporal and spatial variability in the near-surface western Gulf of Mexico. Concentrations of both isotopes during March 1976 were on the order of 22 to 26% greater than those observed during February 1973; analytical differences cannot account for this increase. Consideration of radium levels in the western Caribbean Sea indicates that there must be an internal source of radium that has a significant but temporally variable influence on near-surface radium concentrations in the western Gulf. Comparisons of radium, salinity, and temperature data from 1973 and 1976 provide evidence that advective transport and mixing of radium-rich shelf water with the interior water column of the western basin is responsible for the variability. By plotting Ra-228 vs Ra-226 from this region, estimates of the apparent shelf-water component in the upper water column can be made. The results indicate 36% over the northern slope, 10 to 18% in the central western Gulf, and 3 to 7% over Campeche Bank. In addition to explaining the observed short-term variations of radium in this region, this information should be useful for environmental impact assessments concerned with industrial discharges on the northern shelf. (Author's abstract)
W85-04712

TRACE METALS IN OXIC LAKE SEDIMENTS: POSSIBLE ADSORPTION ONTO IRON OXYHYDROXIDES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W85-04757

5-ALPHA(H)-CHOLESTAN-3-ALPHA-OL IN SEDIMENTS: CHARACTERIZATION AND GEOCHEMICAL SIGNIFICANCE,
Geneva Univ. (Switzerland). Mass Spectrometry Center.
F. Mermoud, F. O. Gulacar, and A. Buchs.
Geochimica et Cosmochimica Acta, Vol. 49, No. 2, p 459-462, February, 1985. 2 Fig, 3 Tab, 23 Ref.

Descriptors: *Lake sediments, *Epicholestanol, *Lake Leman, *Switzerland, Bacteria, Geochemistry, Stanols, Sterols, Eutrophication.

An unambiguous characterization is reported of epicholestanol and its diagenetic behavior in the top five centimeters of sediment collected at the deepest point of Lake Leman, Switzerland, 309 meters below water-level. The gas chromatogram revealed the presence of five C27 stanols in the first centimeter of sediment. The concentration of the five C27 stanols increased relative to the total sterol content down to a burial depth of 3 cm. Below, the trend reverses itself and the relative concentrations of most of them decrease to a value which is close to that observed in the first centimeter, except for epicholestanol which has completely disappeared below 5 centimeters. The two potential sources are an external source (either aquatic or terrestrial) and a bacterial in situ production. In all the sediment cores analyzed, no other stanol than epicholestanol completely disappears with burial below 5 cm, which corresponds to approximately 40 to 50 years of sedimentation. The appearance of epicholestanol is probably related to a change in the bacterial fauna which occurred around the middle of this century and which may be related to the growing eutrophication of the lake. This stanol was not observed in the more oxic sediments of Lake Leman which were studied. (Baker-IVI)
W85-04759

GEOCHEMICAL BEHAVIOR OF INORGANIC GERMANIUM IN AN UNPERTURBED ESTUARY,
Florida State Univ., Tallahassee. Dept. of Oceanography.
P. N. Froelich, G. A. Hambrick, L. W. Kaul, J. T. Byrd, and O. Lecointe.
Geochimica et Cosmochimica Acta, Vol. 49, No. 2, p 519-524, February, 1985. 3 Fig, 2 Tab, 20 Ref.
NSF grants OCE81-25223 and OCE82-00929.

Descriptors: *Ochlockonee Bay, *Florida, *Estuaries, *Germanium, *Silicon, Geochemistry, Seasonal variations, Silicates.

Ochlockonee Bay is a small, shallow, coastal-plain estuary whose only fresh water source is the pristine Ochlockonee River, which drains a forested watershed of which the lower 100 km is a natural wilderness. It is a vertically well-mixed estuary displaying simple dynamics, and showing no sign of anthropogenic contamination. The biogeochemical behavior of inorganic germanium was generally similar to that of silica, being taken up by siliceous organisms during the spring, and being regenerated in the fall. Excess Ge-input observed in the fall may be due to release from fluvial particulates transported into the bay. The Ge/Si ratio in the Ochlockonee River and the ratio transported out of the estuary to the sea are near the reported averages for global continent weathering; thus natural estuarine processes do not obscure the continentally-weathered Ge/Si ratio entering the ocean. (Baker-IVI)
W85-04760

EFFECT OF IONIC INTERACTIONS ON THE OXIDATION OF METALS IN NATURAL WATERS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
F. J. Millero.
Geochimica et Cosmochimica Acta, Vol. 49, No. 2, p 547-553, February, 1985. 7 Fig, 2 Tab, 37 Ref.
NSF OCE 8120659, ONR N014-80-C0042.

Descriptors: *Ionic interactions, *Iron, *Copper, *Oxidation, Natural waters, Seawater, Oxidation, Chlorides, Sulfates.

Most rate processes in natural waters take place in an ionic medium. The effect of ionic interactions of the major components of natural waters on the oxidation of Cu(I) and Fe(II) was examined. The various ion pairs of these metals have different rates of oxidation. For Fe(II), the chloride and sulfate ion pairs are not easily oxidized. The measured decrease in the rate constant at a fixed pH in chloride and sulfate solutions agrees very well with the values predicted. Equations are given for the effect of pH (6 to 8) on the oxidation of Fe(II) and Cu(I) in water and seawater. Unlike the results for Fe(II), Cu(I) chloride complexes have measurable rates of oxidation. The differences in the oxidation rates of Fe(II) and Cu(I) chloride complexes point out the importance of composition effects of natural waters. Further measurements are needed to elucidate these effects and lead to methods that can be used to estimate the rate of oxidation and reduction of ionic solutes in seawater from the results in pure water. (Baker-IVI)
W85-04761

MAJOR ION CHEMISTRY AND SENSITIVITY TO ACID PRECIPITATION OF SIERRA NEVADA LAKES,
California Univ., Santa Barbara. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W85-04789

MODELING THE EFFECTS OF ACID DEPOSITION: ASSESSMENT OF A LUMPED PARAMETER MODEL OF SOIL WATER AND STREAMWATER CHEMISTRY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5C.
W85-04792

LAKE ONTARIO OXYGEN MODEL. 1. MODEL DEVELOPMENT AND APPLICATION,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2H.
W85-04801

LAKE ONTARIO OXYGEN MODEL. 2. ERRORS ASSOCIATED WITH ESTIMATING TRANSPORT ACROSS THE THERMOCLINE,
Johns Hopkins Univ., Baltimore, MD. Dept. of Geography and Environmental Engineering.
For primary bibliographic entry see Field 2H.
W85-04802

RELATIONSHIPS BETWEEN ARSENIC AND OTHER ELEMENTS (IRON, ALUMINIUM, MANGANESE ETC) IN SURFACE SEDIMENTS OF BOHAI BAY (IN CHINESE),
Academia Sinica, Qingdao (China). Inst. of Oceanology.
X. Ma, Q. Li, W. Shen, X. Zhang, and L. He.
Oceanologia et Limnologia Sinica, Vol. 15, No. 5, p 449-456, September, 1984. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Sediments, *Arsenic, *Bohai Bay, *China (Peoples Republic), Iron, Manganese, Titanium, Organic matter, Coastal waters, Heavy metals, Bays.

Total As, Fe, Mn, Ti and organic matter (Org) were determined in 50 surface sediment samples from the Bohai Bay. After extraction of the sediments with Tamm solution (a mixture of oxalic acid and ammonium oxalate) As, Al, Fe and Mn in the extracts and As, Mn, Fe and Ti in the residues were also determined. The distribution of total arsenic in the sediments of the Bohai Bay shows that arsenic contents are related to the type of sediment: lower in silty sediments, higher in muddy sediments. The arsenic in sediments of the Bohai Bay is mainly derived from suspended matter in river and other effusion from land, or coprecipitated with hydrous oxide of iron, aluminium and manganese from sea water. The Bohai Bay may be divided into two parts according to Eh: ranging from 0- -50 mV in the north and 0- +70 mV in the south. The multiple correlation coefficients of extractable elements in the surface sediments of the Bohai Bay are higher in the south part than in the north: the r for As (Fe, Mn, Al, Org) being 0.819 in the south, and 0.511 in the north. Extractable As in the south of the bay may be expressed as a regression equation: As = 1.23 + 0.928 Mn + 9.43 Al + 3.35 Fe - 0.903 Org where, As in x 10 to the -4%, Mn in x 10 to the -2%, Al, Fe, and organic matter in %. The regression equation shows coprecipitations of 1000 micro-g of Mn, Al, and Fe with 9.28 micro-g, 0.943 micro-g and 0.335 micro-g As respectively. The partial correlation cofficients of the extractable As, Al, Fe and Mn is also higher in the south than in the north, with the r for AlFe.AsMnOrg being the highest. Because of the partial and multiple correlation cofficients of Fe, Ti, Mn and As in residues of sediments extracted by Tamm solution being higher, it appears to be that they are intergrowth in aluminosilicates. (Author's abstract)
W85-04835

PREDICTING THE EFFECT OF MACROBENTHOS ON THE SEDIMENT/WATER FLUX OF METALS AND PHOSPHORUS,
Connecticut Univ., Storrs. Biological Sciences Group.
W. M. Starkel.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 1, p 95-100, January, 1985. 3 Fig, 2 Tab, 17 Ref. DOE contract DE-AC09-76SR00819.

Descriptors: *Benthos, *Invertebrates, *Sediment-water interface, *Metals, *Phosphorus, Mixing, Aquatic insects, Iron, Manganese, Dissolved oxygen, Carbon, Potassium, Sodium.

Exchange between sediments and water is an important aspect of the movement of materials and energy in lakes. The effect of macrobenthos on exchange processes was studied in a small, softwater lake. The profundal macrobenthos is composed mainly of Chaoborus larvae at densities often exceeding 20,000/sq m. Chiromomid larvae are much less abundant but account for 5% of the total mass of macroinvertebrates. The log-transformed flux rates of iron, manganese, and phosphorus were linearly related to the biomass of Chaoborus and chironomid larvae. Flux rates were measured by measuring the change in chemical concentrations in the water overlying the sediment of undisturbed cores incubated in situ for 1-2 d. Predicted flux rates of iron and phosphorus at average pelagic densities of animals were enhanced at least twofold over predicted fluxes for diffusion alone. Macroinvertebrates had no apparent effect on flux rates of dissolved oxygen, dissolved inorganic carbon, potassium, or sodium. Because both iron and phosphorus have concentration gradients across the sediment/water interface, a mixing effect, rather than excretion alone, is implicated for the effect of animals on phosphorus flux. (Moore-IVI)
W85-04839

CELLULAR PHOSPHORUS CONCENTRATION AS A CRITERION FOR TROPHIC STATUS IN RAPIDLY FLUSHED LAKES,
Maine Univ. at Orono. Land and Water Resources Center.
For primary bibliographic entry see Field 2H.
W85-04846

NITRATE CYCLING IN LAKE TITICACA (PERU-BOLIVIA): THE EFFECTS OF HIGH-ALTITUDE AND TROPICALITY,
California Univ., Davis. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W85-04896

EFFECTS OF ECOLOGICAL PERTURBATIONS ON DIATOM DYNAMICS IN THE MODEL OF LAKE JEZERO,
Institut Rudjer Boskovic, Zagreb (Yugoslavia). Center for Marine Research.
For primary bibliographic entry see Field 2H.
W85-04901

WATER QUALITY OF THE COLORADO RIVER SYSTEM: HISTORICAL TRENDS IN CONCENTRATION LOAD, AND MASS FRACTION OF INORGANIC SOLUTES,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 2E.
W85-04942

2L. Estuaries

PHYTOPLANKTON PRODUCTION IN THE CORPUS CHRISTI BAY ESTUARY,
Texas Univ. at Austin, Port Aransas. Marine Science Inst.
R. W. Flint.
Contributions in Marine Science, Vol. 27, p 65-83, September, 1984. 6 Fig, 3 Tab, 49 Ref.

Descriptors: *Phytoplankton, *Primary productivity, *Corpus Christi Bay, *Texas, *Estuarine environment, Limiting nutrients, Organic carbon, Seasonal variation, Salinity, Turbidity, Macrophytes, Algae, Cycling nutrients.

The Texas Gulf coast is characterized by a number of subtropical estuaries which have great economic and ecologic value in that they support important regional fisheries through production of new organic matter by phytoplankton photosynthesis. One of these estuaries, the Corpus Christi Bay ecosystem, was studied for a three-year period to define temporal and spatial variability in its primary production and to elucidate environmental factors important in regulating production. Mean annual phytoplankton production at the various sampling sites increased with distance from the riverine influence of the estuary. This pattern was most closely associated with deeper, less-turbid waters at the oceanic end of the estuary that provided a greater euphotic zone. Variability in measured primary productivity rates between sites was most influenced by water column nutrients in January and July and more significantly correlated to salinity changes in April and October. From the three years of data, annual phytoplankton production was estimated to be 174.1 g C/sq m/yr, which represented 52% of total new organic production in this estuary. In contrast, macrophytes and tidal flat algae comprised the remainder of new organic carbon production. Annual production was found to be most significantly affected by freshwater input from either river flow or rainfall, depending upon where production measurements were made in the estuary. High turbidity of this estuarine ecosystem was thought to limit production in contrast to other north American estuaries. Long-term maintenance of primary production in this estuary is accomplished through nutrient recycling while acute changes from both meteorologic and hydrologic forcing cause short-term increases in production that sustain steady-state and replenish lost materials to the system. (Author's abstract)
W85-04432

DEVELOPMENT AND USE OF A THEORETICAL MATHEMATICAL MODEL FOR THE MEDWAY ESTUARY,
Southampton Water Authority (England).
I. S. Gascoine, and K. M. Jury.
Water Pollution Control, Vol. 3, No. 1, p 31-41, 1984. 5 Fig, 2 Tab, 7 Ref.

Descriptors: *Estuaries, *Water quality control, *Medway Estuary, *England, Mathematical models, Model studies.

Theoretical models of the Medway Estuary are presented which have been an invaluable aid in examining the options available for achieving the criteria set for the estuary. The models have enabled the Water Authority to examine and cost the development of resources in the Medway Study Area and will continue to be used to this end, and for setting effluent standards in the future. The purpose of the theoretical model was to examine the physical, biological and chemical changes occurring within the estuary and thus be able to predict water quality (dissolved oxygen and chloride) resulting from changes in natural and imposed conditions. The natural condition variables examined included freshwater flow, tidal height, meteorological conditions, mud respiration and photosynthesis. Imposed conduits were the effluent condition needed to achieve the water quality criteria together with the discharge of effluents related to tide, discharging effluents further down the estuary, seawater recirculation and artificial reaeration. Three models were devised; the first for calculating water levels, a second which was a steady state water quality model which could be used when photosynthesis could be ignored, and the third which was a time-dependent model incorporating a model for photosynthesis. (Baker-IVI)
W85-04450

OYSTER REEFS AS PROCESSORS OF ESTUARINE MATERIALS,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research.
R. F. Dame, R. G. Zingmark, and E. Haskin.
Journal of Experimental Marine Biology and Ecology, Vol. 83, p 239-247, 1984. 4 Fig, 2 Tab, 25 Ref. NSF grant DEB-8119752.

Descriptors: *Estuarine environment, *Oysters, *Food habits, *Cycling nutrients, Ammonia, Organic carbon, Chlorophyll a, Filter feeders, Mollusks.

Oyster reefs are dense concentrations of filter-feeding animals in estuarine ecosystems. A flow-through plastic tunnel is a feasible method of determining significant changes in material concentrations in tidal waters passing over an oyster reef. The oyster reef reduces the amplitude of the particulate organic carbon and chlorophyll a signals while increasing the amplitude of the ammonia signal. The observations suggest that oyster reefs have one of the highest reported release rates of ammonia (1680-7250 micro g at/sq m/h), and thus are probably important in material cycles in marsh-estuarine ecosystems. The magnitude of particulate organic carbon removal by the oyster reef is many times greater than that expected from biofiltration alone, suggesting that removal due to physical factors may be important. (Author's abstract)
W85-04483

EVALUATION OF A MOVING-CO-ORDINATE SYSTEM MODEL OF SALINITY INTRUSION INTO THE MERSEY ESTUARY,
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, and C. H. Lin.
Water Pollution Control, Vol. 82, No. 3, p 402-417,

1983. 15 Fig, 5 Tab, 16 Ref.

Descriptors: *Estuarines, *Mathematical models, *Saline water intrusion, *Moving coordinate systems, Salinity, Mersey Estuary, England, Model studies, Dispersion.

The Mersey estuary is used as an example to investigate the sensitivity of salinity predictions to various input parameters. A brief description of the available field data is followed by an estimation of the probable order of magnitude of numerical errors in the mathematical model to be used. Numerical experiments, for both an idealized and a real case, suggest that numerical errors can be contained so that useful results can be found. The relative merits of fixed and moving co-ordinate systems need to be examined for each application. For calculations covering several repeating tidal cycles the moving cordinate system will probably be the more economic. In a moving coordinate system, the use of a single longitudinal salinity profile for calculating dispersion coefficients is not advised for estuaries which have small depths at low water unless good quality hydrographic data are available. The use of a spatially and temporally mean value of dispersion coefficient was found to give fairly good results for salinity representation. This form of coefficient is preferred for solute transport models. A simple method of finding a mean value of D gave reasonable salinity model results. The method was based on bank-side samples which are usually fairly easy, and hence relatively cheap to collect. The salinity distribution in the Mersey estuary has been found to be sensitive to river flow, hydrography and values of dispersion coefficient. (Baker-IVI)
W85-04528

NOTE ON THE PREDICTION OF DISSOLVED OXYGEN CONCENTRATION IN ESTUARIES,
Birmingham Univ. (England). Dept. of Civil Engineering.
J. R. West, and C. H. Lin.
Water Pollution Control, Vol. 82, No. 3, p 418-429, 1983. 9 Fig, 3 Tab, 19 Ref.

Descriptors: *Dissolved oxygen, *Estuaries, *Prediction, Water quality control, Management, Water quality, Oxygen, Model studies, Boundary conditions.

The objectives of investigating whether improvements in the predictive capability of dissolved oxygen-type (DO-type) water quality models would be useful, and if so, to see if the improvements can realistically be sought, have been achieved. A sensitivity analysis of the specific case of a DO-type time-dependent one-dimensional moving-coordinate estuary model showed that with several uncertain boundary conditions and rate coefficients the model can be tuned to fit field data. Model water quality parameters were particularly sensitive to reaeration coefficients, dispersion coefficients and pollutant loads. The river discharge, and the rate coefficients and boundary conditions associated with the major pollutant loads were also significant. The degree of sensitivity of the water quality parameters was such as to indicate that an improved accuracy is needed for the input parameters for predictive results in the context of water-quality management. Improvements in the pollutant load data should be achievable by an increase in data collection effort. Improvements in defining the correct mechanisms and in determining better estimates of rate and dispersion coefficients should be obtainable from further research effort. (Baker-IVI)
W85-04529

COMPARISON OF LEACHING LOSSES FROM DECOMPOSING LITTER OF THE TERRESTRIAL AND MARSH PLANTS ON LAND AND IN WATER,
Max-Planck-Inst. fuer Limnologie zu Ploen (Germany, F.R.).
B. Gopal.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 947-950, October, 1984. 1 Fig, 2 Tab, 18 Ref.

Descriptors: *Litter, *Decomposing organic matter, *Leaching, Littoral environment, Organic matter, Intertidal areas, Marshes, Plants, Detritus.

Differences in leaching from terrestrial and marsh plant litter decomposing on land and in water are presented. Fresh plant litter of five species namely, Alnus glutinosa, Calamogrostis sp., Scirpus lacustris, Salix viminalis and Typha angustifolia, was collected from the Schohsee and its vicinity during November of 1982. In the first month, the five species differ considerably from each other in the rate and amount of weight loss. Typha angustifolia shoots released maximum amount of water soluble substances throughout the 30 day period. In Calamogrostis sp. the losses were smallest. In Alnus glutinosa more than 18% ash-free dry weight (AFDW) was lost within the first 3 days while nearly the same amount was lost in 7 days in T. angustifolia from the litter placed in water. The data on the changes in the ash content of the decomposing litter indicates the nature of the leached substances. In the three terrestrial species the ash content had increased while in the two marsh species it decreased greatly. The increased ash content can be partly due to contamination by silt, but it is likely that little of inorganic substances were leached. A fall in the ash content clearly shows release of inorganic substances together with the organic substances. Nitrogen content of the litter decomposing in water increased with time except in Alnus glutinosa where it decreased. It is possible that leaching is partly responsible for slow rate of decomposition and accumulation of detritus, more in aquatic environments than on land. (Baker-IVI)
W85-04553

NATURAL FACTORS AND HUMAN MODIFICATIONS CONTRIBUTING TO MARSH LOSS IN LOUISIANA'S MISSISSIPPI RIVER DELTAIC PLAIN,
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
L. A. Deegan, H. M. Kennedy, and C. Neill.
Environmental Management, Vol. 8, No. 6, p 519-528, November, 1984. 3 Fig, 3 Tab, 38 Ref.

Descriptors: *Coastal marshes, *Geology, *Habitat loss, *Environmental effects, *Mississippi River Delta, *Louisiana, Wetlands, Marshes, Canals, Construction, Spoil banks, Deltas, Statistical models.

The disappearance of coastal marshes in the Mississippi River Delta region of Louisiana is a chronic problem. The estimated annual loss is 10,200 ha of coastal land. Causes for the marsh loss can be divided into two general categories: the natural geologic process of delta decay; and human modifications in the coastal zone. Information on regional geology and human-induced habitat alterations are combined in a statistical model to evaluate the relative importance of human and natural factors to marsh loss. Data on marsh area and habitat type for 139 7.5-min quadrangles were calculated from maps based on aerial photographs from 1955/56 and 1978, and data on regional geology obtained from published maps were used to construct a multivariate model relating initial marsh area, change in urban and agricultural area, change in canal and spoil area, canal area in 1978, depth of sediment overlying the Prairie terrace, and subdelta age to marsh loss. Between 25.0% and 39.0% of the marsh loss that occurred during the 23-year period was related to canal and spoil construction, and between 9.5% and 12.7% was related to urban and agricultural development. These are minimal estimates of loss because they do not include many secondary effects that can also result in indirect loss. Depth of sediment, initial marsh area, delta lobe age by 1978 canal and spoil area interaction, and indirect effects not included in the model accounted for remaining marsh loss. The approach of combining data from aerial photographs with other local information to construct models to aid in developing regional management strategies has potential application to other locations. (Moore-IVI)
W85-04603

INORGANIC NUTRIENTS OCCURRING IN THE OXYGEN-DEFICIENT BOTTOM WATER OF OSAKA BAY,
Osaka Prefecture Fisheries Experimental Station (Japan).
For primary bibliographic entry see Field 2K.
W85-04606

CONCENTRATIONS OF SEABIRDS ALONG THE FACE OF GLACIERS AND OUTLETS OF RIVERS IN SVALBARD (KONSENTRASJONER AV SJOFUGL LANGS KANTEN AV ISBREER OG UTENFOR BREELVER PA SVALBARD),
Norsk Polarinstitutt, Oslo.
F. Mehlum.
Fauna, Vol. 37, No. 4, p 156-160, 1984. 4 Fig, 10 Ref.

Descriptors: *Seabirds, *Upwelling, *Glaciers, *Reaction currents, *Svalbard, *Norway, Birds, Kittiwakes, Fulmars, Feeding, Rivers.

Concentration of seabirds at fresh water outflows along glacier faces and at outlets of small rivers are reported from Nordaustlandet and Kongsfjord in Svalbard. The birds, primarily kittiwakes Rissa tridactyla and fulmars Fulmarus glacialis, were seen foraging in dense flocks on the sea surface. The aggregation of feeding organisms is presumed to be caused by passive upwelling. The outflow of fresh water generates a reaction current of salt water (below the fresh water) towards the glacier face or river outlet. (Author's abstract)
W85-04608

TYPHETUM ANGUSTIFOLIAE AND TYPHETUM LATIFOLIAE AS INDICATORS OF VARIOUS HABITATS,
Warsaw Univ. (Poland). Dept .of Phytogeography.
S. Klosowski, and H. Tomaszewicz.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 3, p 245-255, 1984. 3 Fig, 3 Tab, 26 Ref.

Descriptors: *Swamps, *Habitats, *Typhetum, *Poland, Wetlands, Vegetation, Nutrients, Bottom sediments, Ecological distribution, Plant populations.

Investigations carried out over the period 1978-1981 in northeastern Poland concerned habitat requirements of two common swamp communities, the Typhetum angustifoliae and Typhetum latifoliae communities. In comparing phytosociological data, and physical and chemical properties of water and substrate from 27 Typhetum angustifoliae and 26 Typhetum latifoliae phytocenoses, it was found that the swamp communities under investigation are linked with different types of habitat and hence possess a certain bioindicative value. Typhetum angustifoliae occurs in relatively clean waters characterized by narrow amplitudes of most parameters and on mineralized bottoms, poor in nutrients. Typhetum latifoliae is linked with considerably more nutritious waters characterized by broader ranges of most parameters and with organic or organic-mineral bottoms having higher values of practically all of the physical and chemical properties analyzed. In comparing the two swamp communities, the complex of physical and chemical properties of the bottom is of greater differentiating importance than properties of the water. The studies also justify of a narrow (based on floristic domination) classification of high swamp communities. (Moore-IVI)
W85-04614

MICROBIAL CONTRIBUTION TO THE MESOTROPHIC ECOSYSTEM OF THE CAMPBELL RIVER ESTUARY DURING SUMMER,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
H. Seki, A. Otsuki, S. Daigobo, C. D. Levings, and C. D. McAllister.
Archiv fur Hydrobiologie, Vol. 102, No. 2, p 215-228, December, 1984. 1 Fig, 5 Tab, 17 Ref.

Descriptors: *Microorganisms, *Mesotrophic ecosystems, *Estuarine environment, *Campbell River Estuary, *Vancouver Island, *British Columbia, Bacteria, Salmon, Aquatic habitats, Habitats.

The Campbell River Estuary on Vancouver Island (British Columbia) at the southern end of Discovery Passage receives freshwater discharge mostly from the Campbell and the Quinsam Rivers. The microbial role in the maintenance of the mesotrophic environment was studied during summer 1983. The system represents one common type of small complex partially modified estuary in the subarctic region. Physicochemical profiles in the water column inside the estuary were almost uniform down to the depth of 1 m. The intricate topography of this estuary was shown to have a reasonable relation with grouping of various small-scale habitats from the oligotrophic to eutrophic ends of the mesotrophic range. Generation times of heterotrophic bacteria, chiefly responsible for the turnover of organic solutes, were typical of the mesotrophic range. The uptake kinetics of a few substrates such as glutamic acid are almost identical with those on the boundary between eutrophic and mesotrophic systems. Young chinook were the dominant salmon in the estuary and transition zones, although juvenile chum, pink and coho salmon were seasonally important. Bacterial dynamics are expected to be relevant to salmonid ecology, as the factors controlling the elements of basic productivity should be relatively independent of the fish. Heterogeneity in environmental conditions was favorable for efficient trophodynamics in the estuarine ecosystem, supporting production of juvenile salmon migrating to the sea. (Collier-IVI)
W85-04673

METHOD TO MEASURE SUSPENDED LOAD TRANSPORTS IN ESTUARIES,

Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.).
G. Krause, and K. Ohm.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 6, p 611-618, December, 1984. 7 Fig, 7 Ref.

Descriptors: *Estuarine environment, *Suspended load, *Weser estuary, *Germany (Federal Republic), *Water currents, *Measuring instruments, Current meters, Optical properties, Tides.

An optical beam-attenuance meter integrated into an Aanderaa current meter was developed for measuring time series of fluxes of suspended material in turbid estuarine water. The light attenuation sensor is self contained and can be attached to any Aanderaa instrument with negligible modifications. The additional package contains the attenuation meter, an interface and a battery with a capacity to operate the package for the same duration as the current meter. A 30 day period of measurements at 10 min sampling intervals was carried out in the estuary of the River Weser. The daily inequality of the semidiurnal tides in the area are much more obvious from peak concentrations than from current velocities. This holds for spring tide and neap tide cycles and is also seen in the seston flux. Progressive vector diagrams of water velocity and seston flux show opposite residual displacements. The mean residual water velocity is 5 cm/s as computed from the progressive vector diagram. Multiplying with the total cross-section at the measuring site yields a transport of 400 cu m/s. This agrees well with river discharge and gives evidence that the measuring site is to some degree representative for the cross-section. Assuming this to hold also for the transport of suspended matter, the total transport into the landward direction would be 106,000 tons in 30 days. This is of the order of the amount of material which is regularly dredged out from above this section. The instrumentation provides a low cost method of data acquisition for both practical applications and also for the scientific requirements for testing existing mathematical models on the transport of suspended matter in the transition area between rivers and the sea. (Collier-IVI)
W85-04675

ECOLOGY OF MEIOFAUNA IN AN ORGANICALLY POLLUTED ESTUARINE MUDFLAT,

Groningen Rijksuniversiteit (Netherlands). Biological Research Ems-Dollart Estuary.
L. A. Bouwman, K. Romeijn, and W. Admiraal.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 6, p 633-653, December, 1984. 7 Fig, 3 Tab, 35 Ref.

Descriptors: *Ems-Dollart estuary, *Netherlands, *Germany (Federal Republic), *Estuarine environment, *Benthos, *Species composition, Mud flats, Water pollution effects, Nematodes, Oligochaetes, Species diversity.

The structure, distribution and seasonal changes of the benthic meiofauna in an organically polluted, tidal, brackish-water mudflat in the Ems-Dollart estuary (Federal Republic of Germany and The Netherlands) were analyzed. Towards the outfall of polluted fresh water, macrofauna disappeared, numbers of meiofauna increased but the diversity of the meiofauna decreased. In the area surrounding the outfall the numbers and biomass of nematodes and oligochaetes increased rapidly in spring and remained high until autumn (c. 1,000,000 individuals/sq m; c. 2g/sq Cm). The benthic fauna comprised small numbers of species, dominated by a few fast-growing diatom-feeding nematodes (Eudiplogaster pararmatus and Dichromadora geophila) and oligochaetes (Amphichaeta sannio and Paranais litoralis). Eudiplogaster pararmatus exhibits brood care and it tolerates low salinities. Dichromadora geophila which is oviparous, behaved similarly regarding tolerances, life cycle and feeding but this species was less successful than Eudiplogaster in colonizing the mudflats near the outfall. The success of the two naidid oligochaete species results from their method of reproduction by means of binary fission. Most organisms fed on benthic diatoms. In spite of intensive mineralization in the mudflat, only one bacteria-feeding organism was found in abundance (the nematode Leptolaimus papilliger). The absence of macrofaunal organisms, e.g. Nereis diversicolor, is probably also responsible for the development of high densities of meiofauna in the upper sediment layers of the mudflats in the vicinity of the outfall. The heavy load of organic waste entering the Dollart reduced the diversity within the benthic ecosystem, but nevertheless a simple system remained, based on the recurrent reoxidation of the sediment surface. (Author's abstract)
W85-04676

NEAR BOTTOM VARIATIONS OF TURBIDITY IN THE ST. LAWRENCE ESTUARY,

McGill Univ., Montreal (Quebec). Inst. of Oceanography.
B. d'Anglejan, and R. G. Ingram.
Estuarine, Coastal and Shelf Science, Vol. 19, No. 6, p 655-672, December, 1984. 14 Fig, 22 Ref.

Descriptors: *St. Lawrence estuary, *Turbidity, *Water currents, *Suspended load, *Optical properties, *Measuring instruments, Optical properties, Suspended matter, Transmissometers, Attenuation, Advection, Resuspension.

Since the movement of sediment particles in estuaries by tidal currents largely takes place by alternation of resuspension and settling, quantitative estimates of suspended transport can only be obtained by synchronized measurement of particle concentration and velocity near the sediment surface. Observations of the turbidity and velocity fields in the near-bottom waters of the St. Lawrence estuary were obtained with a package which includes an Aanderaa RCM-4 current meter and a modified Partech Suspended Solid Monitor which is interfaced to a twelve-channel Aanderaa data logger. The former also measures salinity and temperature. Observations were made in the South Channel of the St. Lawrence middle estuary between Quebec and the Saguenay. Time series varying in length between 26 h and 26 days, and with repetition rates between one and 15 min were obtained for 3 typical open-channel and nearshore stations. Burst sampling of the turbidity field shows the importance of high frequency variability. With lower frequency records having lengths of one week to one month, contributions to the turbidity fluctuations due to the spring-neap oscillations, seasonal changes in run-off, and the sudden rise in solid discharge of local tributaries following storms, can be resolved. From turbidity polar diagrams, local onshore sources of particulate suspended matter can be identified. Among other advantages, it is possible from such records to time precisely the occurrence of turbidity peaks in relation to the ebb and flow velocities, to assess the importance of resuspension, and to specify exactly the time rate of change of the turbidity. The area sampled showed a dominance of advection over local resuspension in determining the medium time scale variations in turbidity. On the whole, self-recording equipment provides a wealth of information unavailable from more traditional hydrocast sampling techniques. (Collier-IVI)
W85-04677

PROPOSED FRAMEWORK FOR DEVELOPING A MULTIDISCIPLINARY WETLANDS VALUATION MODEL,

North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
J. A. Leitch, K. W. Easter, and W. C. Nelson.
Environmental Professional, Vol. 6, No. 2, p 117-124, 1984. 2 Fig, 15 Ref.

Descriptors: *Model studies, *Economic aspects, *Wetlands, *Value, Research priorities, Ecosystems, Economic evaluation.

The task of wetlands valuation cannot be completed by members of any one discipline. Output measurement and benefit evaluation of wetlands are so complex that a comprehensive investigation must be made of the myriad of biological, physical, social, and economic interactions. An overall research framework is needed that will involve input from economists, anthropologists, hydrologists, botanists, ecologists, and other specialists who are concerned with wetlands ecosystems. The lack of cooperative research has resulted in critical gaps in knowledge that have led to inefficient wetlands allocation by the government. A conceptual framework is presented which guides the researcher from a physical-biological component, through a user interface, to the policy objectives of economic efficiency, social well-being, and environmental quality. Management options and a feedback loop (for estimating the consequences of use in one period on outputs in the next period) are considered in the model. Successful monetary valuation of prairie wetlands will hinge on: successful simulation of the ecosystem and its outputs; identification of those members of society who derive benefits from wetlands products and services; and the ability to estimate those values. Independent researchers may follow the framework presented and contribute to the eventual implementation of the model by identifying the links between the ecosystem and the social system. (Collier-IVI)
W85-04684

BIOTURBATION AND MICROBIAL ACTIVITY,

Centre National de la Recherche Scientifique, Marseille (France). Lab. d'Ecologie et Biochimie Microbiennes du Milieu Marin.
R. Daumas, and M. Bianchi.
Ergebnisse der Limnologie, Vol. 19, p 289-294, December, 1984. 3 Fig, 12 Ref.

Descriptors: *Bioturbation, *Molluska, *Microorganisms, *Clams, *Sediments, *Coastal waters, Ammonia, Adenylates, Nucleotides, Bacteria, Adenosine triphosphate, Adenosine diphosphate, Peptone.

Macrofauna can cause a notable change of biogenic activity in the sediments of coastal waters. Measurements of NH4, adenylates, nucleotides, and bacterial numbers were used to detect the influence of the bivalve Ruditapes decussatus on the bacterial population. The experiments were performed in a sediment composed of fine sand and mud sampled from the Mediterranean near Marseille, France, and placed in an experimental apparatus. In the containers with clams the number of bacterial colonies was notably lower than in the others while it remained stable, or decreased slightly in the control (blank). The blank showed a virtually stable rate in A.T.P., while A.D.P. increased regu-

larly, indicative of an equilibrium population. Development of autochthonous bacteria after enrichment of overlying water with peptone permitted observations on predation on bacteria by the bivalve; in the 'peptone' container, the rate of A.T.P. decreased beyond 12 hours, while A.D.P. remained stable, indicating a population moving towards a degradation phase. In the 'clams' container, adenylates decreased rapidly after 12 hours, particularly for the A.T.P. Adenylates increased exponentially in the blank container which received neither peptone or clams. A large part of the peptone has probably been made unavailable for the bacteria in overlying water, justifying use of high concentrations for experiments in the specific conditions of the superficial layer of sediments. Results of this study suggest that the classical methods of activity measurements may not adequately reflect the dynamics of some biochemical compounds. (Collier-IVI)
W85-04704

OPPORTUNITY COSTS OF PRESERVING COASTAL WETLANDS: A CASE STUDY OF A RECREATIONAL HOUSING DEVELOPMENT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6B.
W85-04754

GEOCHEMICAL BEHAVIOR OF INORGANIC GERMANIUM IN AN UNPERTURBED ESTUARY,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W85-04760

FLUID TRANSPORT PROCESSES IN UPPER SPENCER GULF,
Adelaide Univ. (Australia). Dept. of Mathematical Physics.
H. S. Green.
Marine Geology, Vol. 61, No. 2/4, p 181-195, November, 1984. 1 Fig, 28 Ref.

Descriptors: *Fluid transport, *Bays, *Upper Spencer Gulf, *Australia, Water circulation, Spills, Currents, Tidal effects, Path of pollutants, Harbors, Dichloroethane.

The modelling of tidal and residual currents in Upper Spencer Gulf was studied in response to an environmental problem. The Gulf is a navigable waterway, with many of the characteristics of a river estuary, between the Flinders Ranges, over 700 m high to the east and a chain of hills almost 300 m high to the west. The Gulf contains residual currents, superposed on the normal tidal currents, of considerable magnitude. The possible establishment of a petrochemical complex on the eastern shore raised a number of environmental questions. The principal product, dichloroethane, a toxic liquid, was to be loaded into ships from a jetty extending over the Gulf. A real danger was found to exist if the chemical were to spill into the Gulf as the transport processes within the water body are such as would carry the heavy, toxic, material in solution to reach the surface and evaporate from the neighborhood of Port Augusta. (Baker-IVI)
W85-04762

PHYSICAL PROCESSES AND POLLUTION IN THE WATERS OF SPENCER GULF,
Adelaide Univ. (Australia). Dept. of Applied Mathematics.
J. Noye.
Marine Geology, Vol. 61, No. 2/4, p 197-220, November, 1984. 7 Fig, 3 Tab, 81 Ref.

Descriptors: *Path of pollutants, *Spencer Gulf, *Australia, *Sediment transport, *Currents, Water circulation, Diffusion, Turbulence, Storm surges, Water temperature, Salinity, Thermal pollution.

Known information of the physical processes which occur in the water of Spencer Gulf (Australia) are reviewed. Circulation and turbulent diffusion are considered in detail as to their effect on pollutant and sediment transport. Sea-level variations in Spencer Gulf are mainly due to the propagation of tides and storm surges from the Southern Ocean through the entrance. These travel northward along the Gulf as long waves. Meteorological forces acting on the surface of the water in the Gulf, seasonal changes in temperature and salinity, and surface waves and swell, also affect the sea level. Tidal streams dominate the currents in this region. These are basically one dimensional and a quarter-cycle out of phase with the tidal elevations, except for the complex water movements which occur in the vicinity of Lowly Point. Wind induced currents, thermohaline circulation and wave driven current are much smaller in magnitude than the tidal streams, but the residual circulation they produce is important to the transfer of pollutants from the Gulf to the Southern Ocean. Waste heat from the original Port Augusta Power Station has raised the local water temperature and additional generators could have a profound, perhaps very detrimental, effect on the local environment. In any calculation of the dispersal of pollutants in Spencer Gulf, the limiting factor is a lack of detailed knowledge of the physical processes and of related sediment transport paths. (Baker-IVI)
W85-04763

REGIONAL VARIATION IN THE DISTRIBUTION OF TRACE METALS IN MODERN INTERTIDAL SEDIMENTS OF NORTHERN SPENCER GULF, SOUTH AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Geology and Mineralogy.
For primary bibliographic entry see Field 5B.
W85-04764

FIRE AND HERBIVORY IN A GREAT SALT LAKE MARSH,
Utah State Univ., Logan. Dept. of Fisheries and Wildlife.
L. M. Smith, and J. A. Kadlec.
Ecology, Vol. 66, No. 1, p 259-265, February, 1985. 3 Fig, 2 Tab, 52 Ref. DOE DE-AC09-76SR00819.

Descriptors: *Fire, *Grazing, *Marshes, *Great Salt Lake, *Utah, Standing crop, Primary production, Flooding, Macrophytes, Aquatic plants, Wetlands, Environmental effects.

The effects of fire and of herbivory by vertebrates on the standing crops and aboveground net primary production of Typha latifolia, Scirpus lacustris, S. maritimus, and Distichlis spicata were investigated in a freshwater marsh adjacent to the Great Salt Lake. Production of T. latifolia, S. lacustris, and S. maritimus vegetation responding after fire was not different from control areas, but flooding following fire eliminated D. spicata. Grazing by wetland vertebrates reduced net primary production of marsh macrophytes. Significant reductions occurred in previously burned areas of T. latifolia (48%), S. lacustris (25%), and S. maritimus (9%), illustrating the importance of the herbivory food chain for inland marshes. Evidence of increased protein in vegetation responding after fire and preferential grazing was consistent with the hypothesis that wetland vertebrates select vegetation of higher nutritive quality. However, alternative hypotheses such as increased foraging efficiency in burned areas could not be dismissed. (Author's abstract)
W85-04825

MINERAL DISTRIBUTION AND ECOLOGICAL ROLE OF A RECENTLY FORMED HALOPHYTE COMMUNITY IN THE GUANABARA BAY RIO DE JANEIRO,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
For primary bibliographic entry see Field 5C.
W85-04851

CHEMICAL SURVEY OF THE VOLTA ESTUARY,
Institute of Aquatic Biology, Achimota (Ghana).
C. A. Biney.
Tropical Ecology, Vol. 20, No. 2, p 284-291, Winter, 1983. 1 Fig, 4 Tab, 14 Ref.

Descriptors: *Volta Estuary, *Ghana, *Chemical properties, Estuaries, Salinity, Water pollution sources, Dissolved oxygen, Biochemical oxygen demand, Nutrients, Water temperature, Sediments, Oil pollution, Beaches.

The River Volta originates in Upper Volta and enters the Gulf of Guinea. The estuary is made up of a complicated series of islands and lagoons ranging from 1 to 15 km from the mouth. Water samples were collected from six sites from the river head to Agakpopanya, 13 km upstream. Within km 8 of the river head, the pattern of ionic dominance was similar to that of sea water, but the surface waters were fresh right to the head. The very low salinity of the surface waters suggest a kind of stratification typical of salt wedge estuaries. High dissolved oxygen levels, low biochemical oxygen demand and low inorganic nutrient concentrations all indicated an unpolluted estuary. Localized enrichment occurred in some areas along the water front. Horizontal variations in nutrient concentrations were mainly related to land runoff. The range of temperatures recorded ofr the estuary was 26.8 to 31.8 C, a reflection of tis tropical status. The surface waters were particularly clear, which is an effect of the Akosombo dam, behind which sediments collect. The clarity and warmth of the waters had encourage the proliferation of aquatic vegetation in the shallower areas. Beach pollutants were of two main types: plastic material trapped on the river side of the sandbar; and oil in the form of tarballs on the seaward edge, probably from tankers on the Gulf of Guinea. (Moore-IVI)
W85-04854

VEGETATION AND PRIMARY PRODUCTION IN A FLOATING FRESHWATER MARSH IN LOUISIANA,
Louisiana State Univ., Baton Rouge. Center for Wetland Resources.
C. E. Sasser, and J. G. Gosselink.
Aquatic Botany, Vol. 20, No. 3-4, p 245-255, December, 1984. 3 Fig, 1 Tab, 18 Ref.

Descriptors: *Floating marshes, *Vegetation, *Primary production, *Lake Boeul, *Louisiana, Floating plants, Aquatic plants, Marshes.

Floating marshes, known locally as flotant, comprise a large proportion of Louisiana's 1.6 million ha of coastal wetland. The freshwater floating marsh surrounding Lake Boeul, Louisianna, is a diverse plant community dominated by Panicum hemitomon (maidencane), with the ferns Thelypteris palustris and Osmunda regalis and the perennial vines Vigna luteola and Polygonum sagittatum. The 72 species noted in the area represent 57 genera. The production of this community (1960 g/sq m/yr) is low compared with values reported for many other marsh communities in the same area. The Spartina alterniflora salt marsh community has a production of about 2500 g/sq m/yr, while the Spartina-patens dominated brackish marsh products in excess of 4000 g/sq m/yr. These latter communities produce new growth year round, and considerable production occurs during the winter, when maidencane shoots are dead. Maidencane is more comparable in production to marsh species such as Phragmites australis (2300 g/sq m/yr) and Spartina cynosuroides (1350 g/sq m/yr) that have a similar growth habit. (Baker-IVI)
W85-04855

SUSPENDED SEDIMENTS AND NUTRIENTS IN WATER EBBING FROM SEAGRASS-COVERED AND DENUDED TIDAL MUDFLATS IN A SOUTHERN AUSTRALIAN EMBAYMENT,
Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs.
D. A. Bulthuis, G. W. Brand, and M. C. Mobley.
Aquatic Botany, Vol. 20, No. 3/4, p 257-266, December, 1984. 3 Fig, 2 Tab, 26 Ref.

Descriptors: *Suspended solids, *Nutrients, *Mud flats, *Seagrasses, *Australia, Nitrogen, Phospho-

rus, Silicates, Tide water, Ebb tide, Bays, Tidal flats.

The concentrations of suspended solids, nitrogen (NH(4+), NO3(-), NO2(-)), phosphorus (total phosphorus, PO4(-3)) and silicate were measured in water ebbing from seagrass-covered tidal mudflats and from adjacent ungrassed mudflats in Western Port, Victoria, Australia. Ebb water was collected on six occasions during January and February (summer) and once during July (winter). From both types of mudflats the concentrations of suspended solids, phosphorus and silicate increased during the last hour of ebb tide with maxima in concentrations reached 0.5 to 1 h before slack water ebb. During the last 1.5-2.5 h of ebb tide the suspended solids, phosphorus and silicate concentrations were higher in the water ebbing from denuded mudflats than from seagrass-covered mudflats. The concentration of nitrogen remained low in water ebbing from both types of mudflats during the day, but increased significantly during a night-time ebb; light-dependent biological uptake of nitrogen is implicated. It is suggested that denudation of seagrass-covered tidal mudflats would lead to increased efflux of suspended solids, phosphorus and silicate from sediments to overlying water. (Author's abstract)
W85-04856

DEGRADATION OF MACROMOLECULAR ORGANIC COMPOUNDS IN A TROPICAL LAGOON (CIENAGA GRANDE, COLOMBIA) AND ITS ECOLOGICAL SIGNIFICANCE,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
H.-G. Hoppe, K. Gocke, D. Zamorano, and R. Zimmermann.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 6, p 811-824, 1983. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Organic compounds, *Decomposition, *Lagoons, *Cienaga Grande, *Colombia, Mangroves, Microbial degradation, Coastal waters, Particulate matter, Primary productivity, Bacterial, Biomass, Enzymes, Dissolved solids, Organic carbon.

The lagoon, Cienaga Grande de Santa Marta, is situated on the Caribbean coast of Colombia. Cienage Grande is 450 sq km in area; 1.5-2.0 m deep, and surrounded by a belt of mangroves. The aim of the study was to determine the sites of highest microbial activity in the lagoon and to compare its activity with other coastal water bodies. Since the shallow water lagoon contains a large amount of particulate matter, it was of special interest to study the degradation of this material and its influence on the microbial population. Primary production and decomposition of organic substances were investigated during the rainy season. Production and mineralization were measured using the oxygen method. Total bacteria numbers and biomass were estimated with epifluorescence microscopy, and the enzymatic degradation capacity of model substrates was determined photometrically. These parameters were measured in the water and sediment of the lagoon itself and also in its effluents and incoming waters. Up to 14% of the bacteria colonized the particles and 62% of the respiration originated in the particle fraction > 8 micro-m. The highest exoenzymatic activities were measured in the sediment and water of the mangrove belt. The mangrove environment is the most productive area of the lagoon, and the abundance of bacteria, especially those adherent to particles, is positively related to the enzymatic activities, which are responsible for a continuous input of low molecular weight organic substances into the dissolved organic carbon pool. (Moore-IVI)
W85-04907

PEDOLOGIC PROPERTIES OF NEW JERSEY TIDAL MARSHES,
Fruit and Food Technology Research Inst., Stellenbosch (South Africa).
A. Z. Jaworski, and J. C. F. Tedrow.
Soil Science, Vol. 139, No. 1, p 21-29, January, 1985. 5 Fig, 5 Tab, 25 Ref.

Descriptors: *Tidal marshes, *Soil properties, *Marsh plants, *New Jersey, Coastal marshes, Salt marshes, Marshes, Salinity, Soil chemistry, Estuarine environment.

Tidal marsh soils of New Jersey are divided into two varieties, protected coastal and estuarine. The soils have an average of 14% organic matter, indicating that they are not organic in a strict sense. Particle-size distribution indicates that the estuarine marsh types have formed under much higher energy conditions than protected coastal types; also, the latter are more saline than the former. Humification in tidal marsh soils increases with depth. Sand grain morphology indicates that surfaces of the grains from the saline tidal marshes are more spherical and chemically weathered than nearby terrestric counterparts. Tidal marshes in New Jersey are estimated to be about 3000 years old and, due to coastal subsidence, are currently migrating landward. Carbon/nitrogen ratios in the tidal marshes range from about 14 to 21. Estuarine sites have greater percentages of expanding clay minerals than the protected marshes. Various plant species in the tidal marshes are associated with different levels of salinity. Phragmites australis and Panicum virgatum are associated with low levels, Spartina alterniflora and Spartina patens with high and moderate levels, and Salicornia europaea with high levels of salinity. (Author's abstract)
W85-04955

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3B. Water Yield Improvement

USE OF ICEBERGS TO SUPPLY WATER (DIE VERWENDUNG VON EISBERGEN ZUR WASSERVERSORGUNG),
Tongji Univ., Shanghai (China).
H. Hantke.
Wasserwirtschaft, Vol. 74, No. 11, p 519-522, November, 1984. 5 Fig, 17 Ref.

Descriptors: *Icebergs, *Water supply, *Antarctic, Melting, Satellite technology, Water resources development.

While the use of icebergs to supply water in central Europe is unnecessary and impractical, the idea is not too far-fetched for Australia, Chile, Peru, and the coast of south-west Africa. Table icebergs (those with a flat top surface) are most suitable for transportation and are abundant in the Antarctic; the Amery, West, and Shackelton ice shelves are in the best geographical location for transport to Australia, while the Ross shelf is suited to the Atacama desert and California, and the Filchner and Larsen shelves are suited to southwest Africa and the Middle East. These and other Antartic ice shelves cover 1.4 million sq km and produce about 1,000 cu km of icebergs/yr. Satellite photos can be used to simplify the process of locating suitable icebergs, which can be found up to 40 degrees south in the Atlantic and to 50 degrees in the South Pacific. Melting must be reduced if long transportation times are to be withstood. The iceberg could be insulated from seawater during transportation to decrease melting by an underwater protective coating or a covering for the entire iceberg. If special towing ships are built, the power:weight ratio should be small. Suggestions for iceberg utilization include increasing melting speed by 4-5 cu m/sec using waste heat from a 1,000-MW power plant; and using the temperature gradient between surface (20-28 C) and deep (3-7 C) ocean water to drive turbines to produce heat, part of which is used to melt the iceberg. The average iceberg towed to Australia with 50% of volume lost during transportation would produce 690 million cu m water. (Gish-IVI)
W85-04625

3C. Use Of Water Of Impaired Quality

BRACKISH GROUNDWATER AS AN ALTERNATIVE SOURCE OF COOLING WATER FOR NUCLEAR POWER PLANTS IN ISRAEL,
Geological Survey of Israel, Jerusalem.
For primary bibliographic entry see Field 4B.
W85-04599

SALINE IRRIGATION WATER: EFFECTS ON SOIL CHEMICAL AND PHYSICAL PROPERTIES,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
R. E. Zartman, and M. Gichuru.
Soil Science, Vol. 138, No. 6, p 417-422, December, 1984. 6 Tab, 18 Ref.

Descriptors: *Irrigation water, *Saline water, *Soil chemistry, *Soil physical properties, Wastewater irrigation, Blow-down water, Saline soils, Sodium, Calcium, Magnesium, Permeability coefficient, Bulk density, Water retention.

Irrigation is becoming a practical means to use saline waste water. The purpose of this paper is to determine the effects of saline irrigation water on soil chemical and physical properties of a Friona fine sandy loam (Petrocalcic Paleustoll). Field plots were furrow-irrigated for 4 years with two saline water of different quality at three quantity levels. Irrigation was with either blow-down water from an electrical generating plant (ECw = 12 dS/m, SAR = 11) or city water (ECw = 1.5 dS/m, SAR = 4.5). Soluble salts increased in all irrigated plots, with the highest concentrations in plots irrigated with blow-down water. ECe values increased from 0.4 dS/m in the control (nonirrigated) plots to 6.0 dS/m in plots irrigated with high levels of blow-down water. Soluble Na, Ca, and SAR increased in all irrigated plots, with the highest values occurring in plots irrigated with high levels of blow-down water. Soluble Mg was greatest in the plots irrigated with city water. Hydraulic conductivities (K) were significantly reduced in the Ap horizons of plots irrigated with high and medium levels of blow-down water. K values ranged from 2 mm/30 min in the Ap horizon of high-irrigation, blow-down water plots to 37 mm/30 min in the control plots. K value for the B horizons, were less significantly affected by irrigation treatments. Bulk density and water retention were not significantly affected by irrigation treatments. (Author's abstract)
W85-04618

3D. Conservation In Domestic and Municipal Use

PEAK USE CHARGE: AN EQUITABLE APPROACH TO CHARGING FOR AND/OR REDUCING SUMMER PEAK USE,
Fairfax County Water Authority, Merrifield, VA.
For primary bibliographic entry see Field 6C.
W85-04687

EMPIRICAL BASIS FOR MUNICIPAL WATER RATES MODIFICATION,
Toronto Univ. (Ontario). Dept. of Geography.
A. P. Grima.
Canadian Water Resources Journal, Vol. 9. No. 3, p 22-39, November, 1984. 3 Fig, 7 Tab, 15 Ref.

Descriptors: *Pricing, *Ontario, *Municipal water, *Metropolitan water management, *Economic aspects, Water management, Water conservation, Water demand.

An empirical understanding of the variables affecting water rates is crucial for the formulation of more rational policies in urban water supply and its pricing. A comparative analysis was made of the costs of supply and water rates in Ontario with an emphasis on developing empirical methods for comparing average costs and marginal costs of

water supply with 'average' rates charged to consumers. Previous studies in Canada and the U.S. demonstrate that water use is price responsive. However, water pricing has not often been used as a policy tool; water charges are typically used to recover construction and operating costs. The few empirical studies suggest that costs of supply explain less than 50 percent of the variance in water rates; this was confirmed in this study. Methods for computing two measures of the marginal cost of supply were applied; in nearly half the municipalities in the sample, water supply production was still a declining cost industry and the declining block rate structure was still appropriate. However, a comparison of marginal cost and water rates indicates that there was considerable underpricing of municipal water. (Author's abstract)
W85-04688

RETROFITTING APARTMENT BUILDINGS TO REDUCE COSTS AND WATER DEMAND,
Hargraft and Sons Ltd., Toronto (Ontario).
D. S. Barclay.
Canadian Water Resources Journal, Vol. 9, No. 3, p 45-47, November, 1984.

Descriptors: *Costs, *Water conservation, *Domestic water, Municipal water, Flow control, Flow rates.

Seventy to eighty percent of the water used in apartments is controllable. Such control can lead to substantial savings in water as well as in energy to heat hot water, making retrofitting of appliances with water efficient devices economically viable within a reasonable time period. Shower heads are the most rewarding to retrofit because of savings of water and fuel costs. Toilets and hot/cold fixtures for faucets in the kitchen and bathroom also provide real savings from retrofitting. However, retrofitting requires effort by the building owner, superintendent and tenants. Furthermore, since maintenance is required, retrofitting with water efficient devices must be viewed as an ongoing program in an apartment building. (Author's abstract)
W85-04690

DEMAND REDUCTION: WATER CONSERVATION THROUGH LEAK DETECTION,
Pitometer Associates, Chicago, IL.
P. W. Kroushl.
Canadian Water Resources Journal, Vol. 9, No. 3, p 48-50, November, 1984. 1 Ref.

Descriptors: *Water demand, *Water conservation, *Leakage, *Water mains, Water distribution, Water loss, Correlators, Geophones, Resource conservation, Municipal water.

A systematic program was developed for the reduction of demand by using several techniques to pinpoint leakage. A large percentage of unaccounted-for water (the difference between 100% and the metered ratio percentage) may disguise excess demand which reduces system pressure. Velocity reduction in water pipes will reduce head losses, raise the water levels and increase system pressure. It may be that the system can function economically by reducing demand. Sources of unaccounted-for water must be assessed to eliminate unnecessary demand; these include: accurate metered delivery, good estimates of main breaks, hydrant flushing and fire flow tests, metering of all facilities, and underground leakage. The first choice for methods of reducing demand caused by leakage would be to conduct a do-it-yourself sounding survey. This approach should be systematic in its approach and long-term in its horizon. If this approach is ineffective, a consultant may be employed to conduct either a sonic survey or a water audit survey. Special equipment such as correlators may be used for determining leak location. The correlator is an expensive device with great potential for improvement; it is very effective when used with an intensifier such as a geophone. (Collier-IVI)
W85-04691

WATER LEAKAGE CONTROL AND SONIC DETECTION,
Heath Consultants Ltd., London (Ontario).
G. W. Hennigar.
Canadian Water Resources Journal, Vol. 9, No. 3, p 51-57, November, 1984.

Descriptors: *Leakage, *Water distribution, *Water mains, Unaccounted-for water, Water loss, Water conservation.

To serve the growing water needs of the population, an emphasis must be placed on resource conservation and the reduction of unaccounted-for water. The greatest economic loss to the water utility industry normally occurs in the distribution system. Even today surveys indicate unaccounted-for figures as high as 50% in some water distribution systems in North America. By using sonic instruments and developing leak detection methods supported by prompt repair programs, European nations have reduced wasted water well below North American acceptance levels; an unaccounted-for figure of 5% is considered high in Europe today. Instruments such as the Globe Geophone and the Metrotech 200L were developed mainly to assist in pinpointing known or suspected leak locations. These work fairly well but are slow and cumbersome for leak search activities. Leak search instruments and procedures have been developed which are keyed to the fact that water leaks create vibrations or frequencies on the pipe wall as the water escapes through the leak orifice. Portable electronic instruments with electrical sound amplification are now commonly used. These are available with or without frequency filtering capabilities; the predominant leak sound frequency is amplified and all other frequencies generally are attenuated to aid in pinpointing and locating leaks in areas with noisy ambient conditions. A new method of sonic water leak detection is Leak Sound Correlation which detects and locates leaks in pipeline networks based on the cross correlation technique. This new method gives the exact position of leaks while showing complete insensitivity to other noises and multipath transmission of sound through the ground. Leakage control programs, practiced and promoted by utilities will encourage individuals to make efforts to conserve water. (Collier-IVI)
W85-04692

MANAGING SUMMER LAWN IRRIGATION DEMANDS: A WATER USE INDEX,
Waterloo Regional Municipality (Ontario).
J. D. Pawley.
Canadian Water Resources Journal, Vol. 9, No. 3, p 66-68, November, 1984. 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Lawn irrigation, *Irrigation management, *Public relations, *Waterloo, *Ontario, Public policy, Water conservation, Water management, Domestic water.

As a consequence of citizen concerns relating to the apparent emergency nature of the imposition of the lawn irrigation bans, the Waterloo Regional Engineering staff devised an early warning and advisory system for water users. Water supplies, especially during periods of summer drought, are limited in the service areas of the Regional Municipality of Waterloo due to limitations on equipped well capacities and the physical condition of the wells between times of repair and rehabilitation. This situation is especially severe in the twin cities of Kitchener and Waterloo. The Regional Municipality of Waterloo now publishes a 'Water Use Index' in numerical and graphical form during the summer months to inform water users as to the current state of water pumpage capability with respect to demand. A graphic depiction of a water spheroid is used with a superimposed index; a 0 represents a full condition and 100 represents an empty condition. The index value of 80 was established as an early warning alert to water users that voluntary water use reductions should occur or a lawn irrigation ban would be imposed. To reduce confusion, the index range was later inverted and revised so that advisory messages begin when the index reaches 25. This index is published in the daily newspaper when a hot dry spell is well underway. At the end of the summer, the use of the index is discontinued when the rainfall is judged sufficient to preclude the possibility of a late summer peak from lawn irrigation. The Water Use Index is valuable as a public information and public relations tool but the actual effectiveness in forestalling lawn irrigation bans is difficult to assess. (Collier-IVI)
W85-04694

LAWN AND GARDEN WATERING REGULATIONS: CONSERVATION THROUGH A WATER USE INDEX,
Maine Univ. at Orono. Canadian-American Center.
R. C. McFarlane.
Canadian Water Resources Journal, Vol. 9, No. 3, p 69-73, November, 1984. 18 Ref.

Descriptors: *Lawn irrigation, *Water conservation, *Water use index, *Public relations, *Waterloo, *Ontario, Municipal water, Lawns.

In communities where water shortages occur, lawn and garden watering can be one of the first uses of water to be reduced or prohibited. The challenge for a water manager faced with this circumstance is to communicate those regulations to the users. One communication technique is a 'water use index', designed to show changing water supply capacity in relation to water shortage regulations. The purpose of this paper is to evaluate the effectiveness of a water use index in regulating public use of water. A case study was selected for analysis, that of a water use index employed by the Regional Municipality of Waterloo, Ontario. Over one thousand households (stratified and randomly selected) were solicited through a telephone questionnaire and the responses were analyzed with non-parametric statistics. The criteria used for the evaluation were: diffusion, saliency, clarity, validity and behavioral change. The results of the study indicate that (1) the dispersal medium for water conservation information must be comprehensive, (2) the saliency and clarity of a water use index are high when a diagram is used, and (3) and index alone is unable to act as an enforcer of regulations or as a modifier of behavior. Improvements have been suggested for more effectively communicating lawn and garden watering regulations to the public. (Author's abstract)
W85-04695

WATER USE REDUCTION THROUGH METERING COULD PROVIDE SIGNIFICANT ECONOMIC BENEFITS TO INUVIK, N.W.T.,
Associated Engineering Services Ltd., Edmonton (Alberta).
N. C. Gridley.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 110-124, 3 Fig, 7 Tab, 7 Ref.

Descriptors: *Water metering, *Water conservation, Water use, Cost analysis, Conservation, *Canada, Cold regions, Cost-benefit analysis.

A study of water use patterns was undertaken in the Town of Inuvik, North West Territory, Canada. Measured water use is compared to typical North American patterns. The value of the water supplied to Inuvik's consumers is estimated, and the cost-effectiveness of water use reduction through metering and other methodologies is determined. Inuvik's 1978 water consumption was approximately 652 L/person/day, or about 2.5 times the water use which would be expected in a similar North American community. Benefits of reduced water use in Inuvik are calculated based on annual operations costs of the water supply and distribution system and value of deferred investments. It is believed tha metering of all consumers and simultaneous modification of billing practices could reduce water use considerably. Economic analysis suggest benefit to cost ratios exceeding 1.0 would be achieved if water use were reduced by only 16 percent; a reduction of 73 percent to expected levels (272 L/person/day) would effect a B/C ratio exceeding 3. The study concludes with economic assessments of other water use reduction strategies expected to be effective in Inuvik.
W85-04919

WATER CONSERVATION IN THE NORTHWEST TERRITORIES - PUBLIC EDUCATION AND AWARENESS PROGRAM,
Environmental Protection Service, Edmonton (Alberta).
B. Armstrong, and B. Milburn.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 125-139, 3 Fig, 4 Ref.

Descriptors: *Water conservation, *Water use, Cost analysis, Conservation, Education, Cold regions, Public policy, *Canada.

A public education and awareness program designed to promote an understanding of the need to conserve water was initiated in the Canadian Northwest Territories (N.W.T.). The campaign is comprised of two segments: 1) seminars suitable for presentation to potential audiences throughout the N.W.T. and 2) a multi-media approach using the mails and television, radio, and newspapers. The objective of the seminars was to acquaint the northern peoples with easy, in-home water conservation methods. Despite a great deal of advertising, seminar attendance was less than expected. One reason may be that the residents of the N.W.T. pay a very low percentage for water and sanitation services and do not realize the direct subsidy they are receiving from the government. In the near future, the consumer will pay a increased percentage of this service. A follow-up media program is being planned, including films, brochures, and seminars.
W85-04920

STUDY OF WATER BLEEDER CONTROL ALTERNATIVES,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
A. Yee, and D. W. Smith.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 152-179, 7 Fig, 4 Tab, 24 Ref.

Descriptors: *Water bleeding, *Control systems, Cold regions, Cost analysis, Computer models, *Canada, Economic evaluation, Laboratory study, *Utilities, Water supply.

The development and evaluation of alternative methods for reducing the amount of water that must be bled from a distribution network for freeze protection are presented. The project involved studying an existing water bleeder system, developing some water bleeder control devices, and evaluating these devices in a laboratory situation. Computer simulations were also conducted in order to determine the effects of reduced bleeder flows on an existing system. The existing water bleeder system chosen for study was that of Whitehorse in the Yukon Territory. The current practice for operators of water bleeders has the City advising them via newspaper and other media ads when to turn on their bleeders each year and, again, when to turn them off. Due to carelessness, or the lack of an economic incentive, some bleeders are turned off later or left on year round. Various alternatives to conventional bleeders were identified for further study as long as the alternatives were compatible with the existing infrastructure; met public health requirements; were easy to install, operate, and maintain; and simple and easy to manufacture. The alternatives considered were: a temperature control device; a timer device; an orifice of flow restricter; and a storage tank that would fill from an existing bleeder line before discharging to a sewer drain. A fifth alternative was later chosen that might have industrial or large commercial applications. A laboratory analysis disclosed that the timer option becomes a feasible alternative to the orifice plate at a delivery/disposal rate of $1.73/cu m. The results of the computer modelling are not as definite as those from the laboratory.
W85-04922

OPERATION AND MAINTENANCE CONSIDERATIONS FOR THE DESIGN OF ARCTIC WATER SYSTEMS,
Alaska Area Native Health Service, Anchorage.
For primary bibliographic entry see Field 6A.
W85-04923

3F. Conservation In Agriculture

SEDIMENTATION PROBLEM IN WATER CONSERVANCY IN CHINA,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
For primary bibliographic entry see Field 4D.
W85-04446

INTEGRATED WATER-ENERGY MANAGEMENT SYSTEM FOR CENTER PIVOT IRRIGATION: FUNCTIONAL REQUIREMENTS,
Agricultural Research Service, Fort Collins, CO.
For primary bibliographic entry see Field 7C.
W85-04742

INTEGRATED WATER-ENERGY MANAGEMENT SYSTEM FOR CENTER PIVOT IRRIGATION: IMPLEMENTATION,
Agricultural Research Service, Fort Collins, CO.
For primary bibliographic entry see Field 7C.
W85-04743

IRRIGATION SCHEDULING UNDER SALINE HIGH WATER TABLES,
California Univ., Davis.
B. R. Hanson, and S. W. Kite.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1430-1434, September-October, 1984. 6 Fig, 2 Tab, 16 Ref.

Descriptors: *Irrigation scheduling, *Saline groundwater, Water table, Root zone, Leaves, Water potential, Groundwater movement.

Many areas in the San Joaquin Valley (California) have saline high water tables. Irrigation scheduling in these areas requires consideration of upward flow of groundwater in the root zone and of salinity levels in the root zone. The leaf water potential, as measured with a pressure chamber, appears to be a reliable and practical scheduling index which will allow for consideration of both upward flow and salinity. Pressure chamber measurements used to schedule irrigation for a grower in a saline high water table area resulted in an increase in the interval between irrigations. Day-to-day variability in climate appeared to have little impact on this method of scheduling irrigations. (Author's abstract)
W85-04744

SPRINKLER DROPLET SIZE DISTRIBUTION ESTIMATION FROM SINGLE LEG TEST DATA,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 8C.
W85-04745

EFFECTS OF ELECTRICITY RATES AND RATE STRUCTURES ON PUMP IRRIGATION: AN EASTERN COLORADO CASE STUDY,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
R. L. Gardner, and R. A. Young.
Land Economics, Vol. 40, No. 4, p 352-359, November, 1984. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Irrigation water, *Economic factors, *Rate structure, *Colorado, Water management, Energy, Irrigation practices, Water use, Water conservation, Pumping, Groundwater.

The effects of electricity rate policy on electricity demand, and the derived effect on irrigation water use, are examined using a case study in eastern Colorado. Empirical demand curves for electricity for pump irrigation are estimated. Alternative rate structures are tested for their effect on electricity and water use patterns, farm income, and utility revenue. Particular attention is given to the problem of modeling a declining block structure. Relative crop prices were found to be more important than electricity rate structures in influencing predicted farm management decisions regarding pump irrigation. Rate structures which charge higher marginal prices for electricity provide farmers with more flexibility in their irrigation decisions in the form of greater rewards for reduced irrigation. One way to prolong irrigation in eastern Colorado is to implement electricity rates that reflect both the higher incremental costs of energy and the increasing scarcity of water in the declining Ogallala aquifer. An increasing block rate structure that ends at long run marginal cost deserves serious consideration in those portons of the region that are expected to experience growing electricity demand. (Baker-IVI)
W85-04752

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

EXPERIENCE IN OPERATING THE BRATSK RESERVOIR,
A. V. Nazarov.
Hydrotechnical Construction, Vol. 18, No. 4, p 171-177, April, 1984. 3 Fig, 1 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 31-35, April, 1984.

Descriptors: *Reservoir operation, *Bratsk Reservoir, *USSR, Operation, Reservoirs, Karst, Lumber industry, Navigation, Hydroelectric power, Reservoir fisheries, Erosion, Seiches, Construction.

The Bratsk reservoir is the largest in the USSR and second largest in the world. Initially, the reservoir was expected to be filled by the end of 1966. However, the actual filling was not completed until September of 1967. During filling and in the first years of operation it was constantly necessary to deal with floating timber in order to ensure normal operation of the hydrostation, navigation safety, conditions for fishery, and fulfillment of the sanitary requirements. Under the effect of wind and currents the surfaced wood moved along the reservoir. Control of the floating wood required considerable expenditures. During seasonal variations of the reservoir level about 160 sq km of the shore zone was subjected to variable flooding and waterlogging. Maximum erosion occurred on expanded stretches, and within their limits on slopes composed of loam and sand deposits. Within the narrows, where the banks are composed mainly of hard and soft rocks and wave action is weak, erosion is negligible. Wind setup and setdown cause maximum denivellation of the water surface. The maximum increase of the level during setup reaches 232 cm and the maximum decrease during setdown is 24 cm. Seiche oscillations with various amplitudes and periods are observed on the reservoir surface. The main uses of the complex are hydropower, water transport, timber floating, water supply, and fishery. For the successful development of the shores of reservoirs it is necessary to select the construction sites with consideration of possible occurrence of karstic and landslide processes; the construction of heavy structures requires special karst-control measures. (Baker-IVI)
W85-04429

GARRISON DIVERSION UNIT - AN UPDATE,
Brandon Univ. (Manitoba). Dept. of Geography.
J. Welsted.
Canadian Water Research Journal, Vol. 8, No. 1, p 51-59, 1983. 1 Fig, 12 Ref.

Descriptors: *Garrison Diversion Unit, *North Dakota, *Manitoba, *International Joint Commission, *Missouri River, *Hudson Bay, Water resources development, Political aspects, Governmental interrelations, International agreements.

The Garrison Diversion Unit (GDU), a massive multi-purpose water resource scheme in North Dakota, has caused controversy between Canada and the United States resulting in a reference to the International Joint Commission (IJC). The IJC concluded that the project as authorized by the United States Congress would adversely affect some Canadian waters particularly with respect to biota transfer from the Missouri System to the Hudson Bay Watershed and therefore recommended against completion of those parts of the project that would affect Canada. However, concern about the project still exists in Manitoba and in North Dakota where, for some time, legal actions stalled the project. Negotiations between Canada and the United States aimed at achieving a final agreement have started, but little progress has been made. In view of continued opposition from Canadian sources and increasing opposition from within the United States, it seems likely that only a scaled down version of the original project will be completed. (Author's abstract)
W85-04574

ZERO SIDE YARD HOUSING, ACCEPTANCE AND STORMWATER MANAGEMENT IMPLICATIONS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
H. Ellis, G. Mulamoottil, and E. McBean.
Canadian Water Resources Journal, Vol. 8, No. 2, p 19-30, 1983. 1 Fig, 3 Tab, 8 Ref, 1 Append.

Descriptors: *Housing, *Storm wastewater, *Zero side yard housing, Urban runoff, Storm runoff, Runoff management, Water quality, Detention reservoirs.

There is expected to be an increased demand for medium-density housing in the next few years. One version of the traditional single-family unit that can be included in medium-density housing is the zero side yard or zero lot line unit. This design is characterized by reduced lot width and the placement of the house on one side of the lot. The zero side yard concept of housing has met with the approval of all concerned agencies in Canada. The potential stormwater management implications associated with zero lot line subdivision designs were investigated using hypothetical test scenarios. Stormwater quantity and quality runoff regimes were generated using the EPA SWM model. The increased runoff quantity and decreased water quality associated with zero lot line developments over that of conventional subdivisions can be significant. Stormwater retention or detention pond volume requirements can increase significantly. (Moore-IVI)
W85-04580

INTERNATIONAL WATER MANAGEMENT IN CANADIAN-AMERICAN RELATIONS, 1894-1907,
Royal Military Coll. of Canada, Kingston (Ontario).
For primary bibliographic entry see Field 6E.
W85-04588

PROBLEMS WITH TRADITIONAL SMALL RESERVOIR IRRIGATION SYSTEMS IN THE SEMI ARID TROPICS,
Sun Trac Corp., Glenview, IL.
P. N. Sharma, and O. J. Helweg.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1451-1454 and 1462, September-October, 1984. 5 Tab, 9 Ref.

Descriptors: *Irrigation efficiency, *Tanks, *India, Reservoirs, Developing countries, Semi-arid regions, Water use, Seepage, Evaporation.

In the semi-arid tropics (especially India), monsoon precipitation is collected in small reservoirs, called tanks, to supply water for supplemental irrigation during the rainy season and full irrigation in the dry season. The widespread use and popularity of tank irrigation systems is mainly due to the seasonality and extremely erratic distribution of the precipitation within the rainy season. Two of these systems were studied in detail to compare their potential overall water utilization efficiency (WUE) with their actual WUE. The overall system WUE's were three to five times lower than their potential WUE. In the traditional systems, three to five times more water is supplied to rice crops than required by its evapotranspirations needs, which results in a very low project water utilization efficiency (usually between 15 and 30 kg/ha/cm). The overall systems water utilization efficiency of traditional tanks is low when compared to the potential water utilization efficiency because of high seepage and evaporation losses in addition to the low project utilization efficiency. These traditional irrigation practices may be improved by use of appropriate cropping systems, better water control, and management. (Moore-IVI)
W85-04747

EFFECT OF DRAIN TUBE OPENINGS ON DRAINAGE AND SUBIRRIGATION,
Civil Engineering Dept., Sallah Al-Din University, Arbil, Iraq.
F. S. Mohammad, and R. W. Skaggs.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1455-1462, September-October, 1984. 12 Fig, 6 Tab, 15 Ref.

Descriptors: *Drainage, *Subirrigation, *Drain tubes, Hydraulic head, Water table, Drawdown.

A laboratory soil tank was used to determine the effect of the drain tube perforations on transient drainage and subirrigation processes. Seven corrugated plastic drain tubes with varying total perforation areas and locations were tested. Experiments were also conducted with a standard drain tube surrounded with a 5-cm thick gravel envelope. Drainage and subirrigation experiments were conducted for three combinations of initial and final water table positions. The pressure head distribution, drainage and subirrigation flow rates were measured continuously during each test and the results are reported. There was an increase in drain flow, drawdown and subirrigation rates with increase in total perforation area up to an area of 38.5 sq cm/m. Doubling the perforation area 79 sq cm/m further increased the drawdown rate and had about the same effect as the use of a 5 cm gravel envelope for the cases tested. Tubes with smaller perforation areas had a greater proportion of the total hydraulic head loss occurring near the drain for both drainage and subirrigation. The water table was backed up over the drain for tubes with smaller perforation areas (1.8 sq cm/m - 8.8 sq cm/m) for more than 40 h after drainage began for all conditions tested. Location of the drain tube perforations had only a small effect on drawdown, drainage outflow and subirrigation rates. More work is needed to determine the effect of hole locations on transient state drainage. (Author's abstract)
W85-04748

ALGORITHMS FOR OPTIMIZING HYDROPOWER SYSTEM OPERATION,
Cornell Univ., Ithaca, NY. Dept. of Environmental Engineering.
J. C. Grygier, and J. R. Stedinger.
Water Resources Research, Vol. 21, No. 1, p 1-10, January, 1985. 2 Fig, 7 Tab, 44 Ref.

Descriptors: *Reservoir operation, *Hydroelectric plants, *Algorithms, Mathematical studies, Linear programming, Optimization, Systems analysis, Water resources development, Multireservoir systems, Computer models.

Three algorithms are compared for optimizing the operation of multireservoir hydrosystems over the medium term. The algorithms considered are a combination of linear programming and dynamic programming, an optimal control algorithm, and successive linear programming (SLP). Of these three, only SLP and the optimal control algorithm consistently found a locally optimal deterministic policy. The SLP algorithm is easier to implement and seems to converge to a global optimum. The optimal control algorithm was significantly faster. Computing costs are reasonable with both algorithms and should increase only as the square of the number of reservoirs in contrast to the exponential growth of dynamic programs. The efficiency of the algorithms, which may be improved further by extensions described in the text, allows the inclusion of multiple streamflow forecasts at modest cost. Since the reservoir operating problem is really a stochastic one, the extension of these algorithms to include uncertainties in inflows with the multiple futures method is important. Deterministic optimization algorithms on modern computers now yield optimal solutions for complex hydrosystems for only a few dollars per run. If this success can be transferred to stochastic or semistochastic algorithms, the benefits in terms of improved efficiency in hydropower generation and water supply could be substantial. (Baker-IVI)
W85-04786

WATER FOR THE FLATS.
Prospect (Johannesburg) Vol. 21, No. 2, p 10-13, 1982. 6 Fig.

Descriptors: *Water supply, *South Africa, *Rural areas, Irrigation, Water resources development, Pipelines, Plastic pipes, Reservoirs, Pumping stations.

The Duivenhoks Rural Water Supply Scheme, scheduled for completion during the 1982/83 financial year is expected to go a long way in improving the quality of life in the Overberg area of the South Western Districts of the Cape of South Africa. The scheme is designed to suply water for domestic purposes and for stock watering to 285 farms with a total of 157,000 hectares and to supply purified water to the settlement at Askraal as well as to the coastal resorts of Witsand, Port Beaufort and Oysterbeds. The primary souce of the proposed scheme is the Duivenhoks River dam with a net assured yield of 10.4-million cu m/annum, of which about 1.1 million cu m will be acquired by the scheme and the remainder can be used to consolidate and extend irrigation along the Duivenhoks River. The area to be supplied with water is generaly known as The Flats due to the level terrain. Water will be pumped from the Duivenhoks River to the purification works and then to a break-pressure reservoir. A gravity main will supply water to Heidelberg and Askraal, while the remaining water will be pumped further to a main reservoir, from which the rural area and coastal resorts will be served. A further pumping station will lift the water for the northern region. Pipelines will consist mainly of PVC piping and will have an overall length of 470 km and range in diameter from about 50 mm to 350 mm. (Baker-IVI)
W85-04811

4B. Groundwater Management

BRACKISH GROUNDWATER AS AN ALTERNATIVE SOURCE OF COOLING WATER FOR NUCLEAR POWER PLANTS IN ISRAEL,
Geological Survey of Israel, Jerusalem.
A. Arad, and A. Olshina.
Environmental Geology and Water Sciences, Vol. 6, No. 3, p 157-160, 1984. 7 Fig, 2 Tab, 2 Ref.

Descriptors: *Groundwater potential, *Brackish water, *Cooling water, *Israel, Beer Sheva, Water supply, Nuclear powerplants, Groundwater recession, Salinity, Saline water intrusion.

The western Negev is being considered as a potential site for the location of a nuclear powerplant. Since this part of Israel has no surface water, the only alternatives for cooling water are piped-in water, Mediterranean water and local, brackish groundwater. The Judea Group aquifer was examined for its potential to provide the required amount of cooling water over the lifetime of the plant, without causing a drastic lowering of the regional water table. The salinity of the water

tends to increase from east to west. Flow within the aquifer is in the direction of Beer Sheva, where the extraction rate is 32 to 35 million cu m/yr. This has resulted in a salinity creep of 5-10 mg Cl per year in the Beer Sheva area, which poses a danger of deterioration of its water supply in the long term. Given the assumed range of aquifer properties, extraction of brackish water for cooling purposes will not result in large changes in the regional water table. Exploitation of the more saline water to the southwest of Beer Sheva could preserve the quality of Beer Sheva's water supply, at the expense of an increase in the depth from which it must be pumped. (Moore-IVI)
W85-04599

LGWRES - LIFE OF GROUND-WATER RESERVES,
Ministry of Planning, Riyadh (Saudi Arabia).
F. A. Rayner.
Ground Water, Vol. 23, No. 1, p 81-84, January-February, 1985. 2 Fig, 3 Tab.

Descriptors: *Groundwater mining, *Water use, Model studies, Safe yield, Water supply, Groundwater recharge.

LGWRES is a simplistic program, for the HP-41C series of programmable calculators, to determine the lifetime of ground-water reserves in years; total use over the lifetime of the reserves; percentage of domestic and agricultural uses; additional years of possible agricultural use realized by dedicating the domestic use to agriculture; and percentages of total use, domestic use, and agricultural use that could be sustained by annual replenishment to the ground-water reserves, within the 'safe yield' concept. (Author's abstract)
W85-04643

MAIN RESULTS OF A PROJECT FOR ARTIFICIAL GROUND-WATER RECHARGE FROM SECONDARILY TREATED SEWAGE IN THE MUNICIPAL FOREST OF THE CITY OF LANGEN (LOWER MAIN REGION) (DIE WICHTIGSTEN ERGEBNISSE EINES PROJEKTES ZUR KUNSTLICHEN GRUNDWASSER-ANREICHERUNG MIT WEITERGEHEND BEHANDELTEM ABWASSER IM LANGENER STADTWALD (UNTERMAINREGION)),
Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany, F.R.).
For primary bibliographic entry see Field 5D.
W85-04809

4C. Effects On Water Of Man's Non-Water Activities

POTENTIAL EFFECTS ON GROUND WATER OF A HYPOTHETICAL SURFACE COAL MINE IN INDIANA,
Geological Survey, Indianapolis, IN. Water Resources Div.
K. J. Banaszak.
Ground Water Monitoring Review, Vol. 5, No. 1, p 51-57, 1985. 7 Fig, 18 Ref.

Descriptors: *Groundwater movement, *Surface mining, *Environmental effects, *Indiana, Water chemistry, Groundwater monitoring, Monitoring, Mining, Forcasting, Model studies.

The possible mine will remove a gently, less than 50 feet per mile, westerly dipping Springfield coal from an area covered by glacial till and some channel sands and gravel. The area is flat with less than 20 feet of relief in a square mile. The channel sands and gravels, the till and the bedrock are capable of yielding groundwater at 5 to 75, 3 to 10, and 1 to 10 gallons per minute (gpm), respectively. The groundwater in the drift and the shallow bedrock is calcium-bicarbonate type, contrasting with the sodium-bicarbonate type in the deep bedrock. The surface mine will feature selective handling of overburden. The probable hydrologic consequences of the mine will be 1) a short-term, areally limited dewatering, 2) an increase in dissolved solids, 3) a change in groundwater chemistry in some areas to a calcium-bicarbonate sulfate water, 4) an increase in groundwater storage, and 5) a new integrated surface water system. The proposed groundwater monitoring system will include seven monitoring wells in the glacial material and one in the bedrock. The primary effort in groundwater monitoring to the west of the mine will be to detect changes in the quality of the groundwater, whereas to the east, changes in both quality and quantity will need to be monitored intensively. (Author's abstract)
W85-04418

EFFECTS OF LAND DRAINAGE ON STREAM FLOW,
Guelph Univ. (Ontario). School of Engineering.
R. W. Irwin, and H. R. Whitely.
Canadian Water Resources Journal, Vol. 8, No. 2, p 88-103, 1983. 1 Tab, 49 Ref.

Descriptors: *Drainage effects, *Streamflow, *Ontario, Flood peak, Tile drainage, Subsurface drainage, Land use, Storage capacity, Rainfall runoff, Channel improvement, Agricultural watersheds.

Every commerical agricultural crop grown in Ontario requires a well-aerated soil for maximum economic production. Soil which does not drain quickly and naturally can be improved by the installation of a subsurface tile drainage system. Over half the agricultural land in Ontario needs this form of drainage improvement. The effects of land drainage on streamflow are reviewed. Conclusions on effects are difficult to establish because response varies with different types of drainage work and differing physiographic and climate situations. Coincident changes in land use, and the high variability of inputs, add complications. Tile drainage provides storage capacity in the soil profile. This storage acts as a reservoir which fills and reduces surface runoff for low intensity storms but will have only a minimum effect for medium and high intensity storms. Tile drainage decreases peak flow up to the point where the soil becomes saturated after which it probably only increases it slightly. If a large portion of a watershed is drained by enlarged surface channels, increased flood peaks may be expected. The effect is damped if contributions to the channel are not synchronized. Channel enlargement will increase flood peaks in unimproved channel sections downstream of the area of improved channel drains. Connection of swamps or enclosed areas to rivers by large arterial drains increases flood peaks. Over the range of rainfalls giving rise to floods, a combination of tile drains and outlet channel enlargement appears to be beneficial in modifying flood peaks. (Moore-IVI)
W85-04583

EFFECT OF ANTHROPOGENOUS CHANGES OF WATER CONDITIONS ON THE VEGETATION IN THE FOREST RESERVE LAS BIELANSKI IN WARSAW (WPLYW ANTROPOGENNYCH ZMIAN STOSUNKOW WODNYCH NA ROSLINNOSC REZERWATU LAS BIELANSKI W WARSZAWIE),
Warsaw Univ. (Poland). Zaklad Fitosocjologi i Ecologii Roslin.
J. M. Chojnacki, and W. J. Mroz.
Wiadomosci Ekologiczne, Vol. 30, No. 2, p 167-192, 1984. 6 Fig, 14 Ref.

Descriptors: *Las Bielanski forest reserve, *Poland, *Forests, *Hydrologic budget, Plant communities, Ecological distribution, Groundwater level, Environmental effects, Vegetation, Habitats.

Water relations at the Las Bielanski reserve in Warsaw were investigated to obtain an estimation of the range and effect of anthropogenic changes, and to consider the possibility of correcting the existing water budget. Investigations were conducted on a section of the reserve in the Vistula valley and on its terraces - the lowest flood terrace, the higher overflood terrace, and partly on the dune terrace. Two groups of plant communities are found: elm-ash forests of Ficario-Ulmetum type on flood terrace and in depressions of the overflood terrace; and oak-hornbeam forests (Tilio-Carpinetum association) on the highest parts of the overflood terrace. The communities dynamics are most visible in the composition and structure of forest stand regeneration. For several centuries man has been responsible for the water relations in Las Bielanski. Anthropogenic changes in water relations, especially the changes in depth of occurrence of ground water, varied both in intensity and their direction. In the last decades, these changes resulted in a gradual drying. The decrease in ground water level took place mainly on the overflood terrace. A decrease in ground water level, a change in its stability and greater drainage by brooks caused the formation of a new system of habitat factors, and a gradual transformation of communities by secondary succession. Former swampy alder forests were transformed into elm-ash forests of Ficario-Ulmetum type, typical moist oak-hornbeam forests and dry oak-hornbeam forests. The restoration of past water conditions may be quite dangerous for the stability of the present, developing system of plant communities. Present moisture relations in the root zone of trees remain within the limits of the physiological tolerance of forest stands. Thus the planned water project should not be put into use. (Moore-IVI)
W85-04610

BRACKISH WATER IN UNSATURATED CONFINING BEDS AT A TEXAS LIGNITE MINE,
Texas Univ. at Austin. Bureau of Economic Geology.
For primary bibliographic entry see Field 2F.
W85-04639

EFFECT OF AGRICULTURAL LAND USE ON GROUND-WATER QUALITY IN A SMALL PENNSYLVANIA WATERSHED,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
For primary bibliographic entry see Field 5B.
W85-04642

TILLAGE INFLUENCES ON EROSION DURING FURROW IRRIGATION,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
E. C. Dickey, D. E. Eisenhauer, and P. J. Jasa.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1468-1474, September-October, 1984. 4 Fig, 5 Tab, 13 Ref.

Descriptors: *Soil erosion, *Furrow irrigation, *Tillage, Runoff, Nutrients, Conservation tillage, Irrigation effects, Cultivation.

Erosion and runoff from furrow irrigation of corn was measured for three conventional and three reduced tillage systems in 1981 and 1982. The plots were located on a Hastings silt loam soil having a 0.5% slope and a 366 m furrow length. Erosion was the least for slot-planting and greatest for the chisel system, ranging from 20 to 340 kg/ha, respectively, for the first 45 min of runoff during the first irrigation. Erosion from the fourth irrigation was about 75% less than from the first irrigation. Cumulative runoff after 45 min of runoff was similar for all treatments. Nutrient losses were minimal for all irrigations monitored. For most tillage treatments, no differences were measured between nonwheel and wheel track furrows for cumulative soil loss, erosion rate, sediment concentration, runoff amount and runoff rate. (Author's abstract)
W85-04749

4D. Watershed Protection

WATERSHED REHABILITATION PROGRAM RELATED TO THE MANAGEMENT OF RIVER AND RESERVOIR SEDIMENTATION IN INDONESIA,
Ministry of Forestry, Djakarta (Indonesia).
E. Sutadipradja, and H. Hardjowitjitro.
Water International, Vol. 9, No. 4, p 146-149, December, 1984. 3 Tab, 4 Ref.

Descriptors: *Erosion, *Indonesia, *Sedimentation, *Reservoirs, *Public policy, Soil conservation, Conservation, Revegetation, Reforestation, Watershed management.

Problems of sedimentation in Indonesia are basically caused by population problems (i.e., high population density, high population growth and unequal distribution) and improper use of the land without appropriate soil conservation measures. The erosion rate on dry land reached nearly 4 cm a year and at present 8.5 million hectares are considered as critical lands. The government of Indonesia has made great efforts to control soil erosion and sedimentation through the watershed rehabilitation program in 36 groups of priority watersheds based on Presidental Instruction Projects. Regreening projects on private lands have involved more than 1.95 million hectares and reforestation projects on state forest areas have an annual target of about 300,000 hectares. These projects have increased land productivity, provided more permanent labor opportunities and have been investigated as economically feasible actions. The government has created, with ample funds, a large field organization as a culmination of all efforts in finding a solution for more effective erosion and sedimentation control. (Author's abstract)
W85-04438

CONTROLLING EROSION AND SEDIMENTATION IN THE PANAMA CANAL WATERSHED,
Minnesota Univ., St. Paul. Dept. of Agricultural Engineering.
C. L. Larson, and W. Albertin.
Water International, Vol. 9, No.4, p 161-164, December, 1984. 1 Fig, 4 Ref.

Descriptors: *Watershed management, *Alajuila Watershed, *Panama, *Canal, Watershed, Erosion control, Erosion, Landslides, Cultivated lands, Slopes, Erosion.

The Alajuila Watershed has a highly developed drainage pattern with narrow valleys and steep, irregular slopes. Unfortunately, 13,400 ha of land in the over 45% slope category have been cleared by colonists and almost half of this is now being cultivated or pastured. After about 2 yr of cultivation, the land is converted to pasture or abandoned due to loss of fertility. Gullies often appear after about 5 yr of pasturing. Landslides are a problem in the steeper portions of the watershed. In early 1978 a task force assembled to study the problem. Three watersheds were selected from a five year project. The major objectives of the project were to protect the watershed from further deterioration by erosion and, in the case of the Canal Watershed, to protect the Alajuela and Gatun reservoirs from accelerated sedimentation. Watershed management activities carried out under the project include plantation forestry, agroforestry, forest reserves, pasture management soil conservation, land-use zoning, community education and new land-use concepts. The ultimate success of a watershed program depends on a sound institutional framework as well as adequate funding. Typically, neither is assured in this case. (Baker-IVI)
W85-04442

ECONOMIC/INSTITUTIONAL ISSUES IN SEDIMENTATION MANAGEMENT IN DEVELOPING COUNTRIES,
Comision Economica para America Latina, Santiago (Chile). Div. of Natural Resources and the Environment.
M. Nelson.
Water International, Vol. 9, No. 4, p 165-168, December, 1984. 2 Fig, 3 Ref.

Descriptors: *Santiago, *Chile, *Developing countries, *Economic aspects, *Watershed management, *Sedimentation, Erosion control, Management.

Economic analysis as an aid to decision on management of sedimentation, rests on use of benefit-cost or cost-effectiveness techniques. The usefulness of such analysis depends on three fundamental conditions; identification of key physical relationships, subject to management intervention, which enable prediction of the cause-effect linkages in generation, transport and deposition of sediment; prediction of economic and financial costs and benefits associated with linkages in the physical system which influence sediment yields and their upstream and downstream effects; and evaluation of the viability and transaction costs of alternative institutional arrangements to undertake activities to change sediment supply and manage downstream consequences. The key economic principles which apply to sediment management are opportunity cost, tradeoffs and diminishing marginal returns, exponential decline in yields or exponential increase in unit costs of production or environmental protection. If resources are used in such a way as to reduce inputs or amenities provided through the water system downstream, as a result of sedimentation, then management requires that society divert investment from other activities to protect the resource base. As a first step it is essential to identify the critical physical cause-effect linkages in erosion and transport and deposition of sediments. The vast majority of sediment management situations in Latin America, Asia and much of Africa are characterized by over-use of the upstream catchments under the prevailing technology. One is faced in these situations with the problem of organizing, maintaining and operating sociosystems to respond to dynamic complex conditions which require changes in both upstream technology and downstream perception of values with respect to development of the floodplain, acceptable risk for investments in this development, and equity and income transfers between upstream and downstream residents. (Baker-IVI)
W85-04443

MANAGEMENT OF SEDIMENT IN NEW SOUTH WALES, AUSTRALIA,
Water Resources Commission of New South Wales, Sydney (Australia).
D. Outhet, and R. Morse.
Water International, Vol. 9, No. 4, p 169-171, December, 1984. 1 Fig, 8 Ref.

Descriptors: *Sedimentation, *Watershed management, *New South Wales, Erosion control, Management, Soil erosion, Land use, Sediment transport.

The amount of sediment in major New South Wales rivers and reservoirs is relatively low compared to world averages. This is a result of relatively low erosion rates, the sediment coarseness and numerous sediment sinks between the eroding parts of catchments and the rivers and reservoirs. In some locations several problems have required attention. These include: sediment blockage of roads and culverts; sedimentation of small reservoirs and recreational lakes; sedimentation on large alluvial fans; river channel damage caused by low sediment supply; and lack of effective government control over soil erosion and sedimentation in the past. Strategies to overcome these problems start with information collection to pinpoint major problems. This enables the preparation of total catchment management plans. These require proper land-use policies, legislation and education of the public for effective implementation. The catchment management plans face several implementation problems. First legislation must be updated to enable Government authorities to coordinate their activities and implement the plan. This avoids the problem of funds going to one organization or problem area at the expense of others that are essential parts of the plan. Another problem is that many landholders believe that their sediment sources are insignificant and also that they have a right to do as they please on their own land. The complexity of the interrelated processes of erosion, transportation and deposition means that any action must be taken in a carefully considered and coordinated manner. (Baker-IVI)
W85-04444

SEDIMENTATION IN NEW ZEALAND HYDROELECTRIC SCHEMES,
Ministry of Works and Development, Wellington (New Zealand).
For primary bibliographic entry see Field 2J.
W85-04445

SEDIMENTATION PROBLEM IN WATER CONSERVANCY IN CHINA,
Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).
D. Wu.
Water International, Vol. 9, No. 4, p 177-180, December, 1984. 3 Fig, 2 Tab, 4 Ref.

Descriptors: *Erosion control, *Sedimentation, *China, Hydroelectric plants, Watershed management, Water conservation, Soil conservation, Sediment managment, Water resources development, Reservoir sedimentaticn.

The state-of-the-art of river sedimentation management in China is reviewed. Attention is focused on the sediment load carried by main rivers in China; the related sediment problems encountered in developing water resources; and the methods in dealing with those problems. There are 50 rivers with annual maximum sediment load exceeding 10 million tons in China. There are more than 400,000 sq km of loess plateaus and hills in the drainage basin of the Yellow River. Inadequate conservation of soil and water leads to erosion, transportation and deposition of sediment, giving rise to much trouble in water conservation works. These problems include flood control, navigational concerns, reservoir sedimentation, and sediment problems of low-head diversion dams or hydroeletric projects. Methods for dealing with sediment problems include water and soil conservation and use of turbid water with emphasis on terracing, strip cropping, forestation, grass and crop rotation. Several types of structures may be built along a gully such as small reservoirs, check dams, drop structures, drainage ditches, and irrigation canal systems for diverting hyperconcentrated flow into farmland or to warp land. Processes for diverting water while preventing sediment from entering water intakes at hydroelectric plants are becoming more advanced. (Baker-IVI)
W85-04446

PRIVATE AND SOCIAL COST - BENEFIT PERSPECTIVES AND A CASE APPLICATION ON RESERVOIR SEDIMENTATION MANAGEMENT,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
F. Hitzhusen, B. Macgregor, and D. Southgate.
Water International, Vol. 9, No. 4, p 181-184, December, 1984. 2 Tab, 14 Ref.

Descriptors: *Developing countries, *Reservoir sedimentation, Sediment transport, Erosion control, Reservoirs, Forest management, Clear-cutting, Costs, Watershed management, Slopes, Agriculture, Dominican Republic, Valdesia dam.

The development of a comparative private and social cost-benefit perspective for sedimentation management in developing countries is considered. The design of optimum policies with respect to sediment management requires a comprehensive conceptualization and estimation of the level and distribution of private and social costs and benefits of alternative strategies. A situation in the Dominican Republic is used as a case application of the method. Clear cutting of several forested areas in the Cordillera Central has brought about a high rate of soil loss. In order to diminish the dependence of that country on imported oil, the Valdesia dam was constructed. Sedimentation in the reservoir has been a matter of continuous concern. Even before a major hurricane swept over the island in 1979 annual sediment yield in the reservoir watershed was estimated at 1.4 million metric tons. The following management policies were developed: in areas with a slope of class A (3-20% slope), continue crop farming on existing cropland; encourage mulching and contour farming and renovate all rangeland with a slope of 13-20%; for areas with a slope of class B (21-35% slope), encourage mixed cropping/agroforestry enterprises on existing cropland and renovate all rangeland; in areas with a slope of class C (36-50% slope), convert all existing cropland to agroforestry and

renovate all rangeland; in areas with slope of class D (over 50% slope), reforest all existing cropland and rangeland. (Baker-IVI)
W85-04447

SYSTEM OF PRACTICES FOR PREVENTING WATER BY AGRICULTURAL CHEMICALS,
Ukrainian Research Inst. of Forestry and Agriculture, Ivanovo-Frankovsk (USSR).
For primary bibliographic entry see Field 5G.
W85-04619

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

DETERMINING TRACE CONCENTRATIONS OF COPPER IN WATER BY CATHODIC FILM STRIPPING VOLTAMMETRY WITH ADSORPTIVE COLLECTION,
Liverpool Univ. (England). Dept. of Oceanography.
C. M. G. van den Berg.
Analytical Letters, Vol. 17, No. A19, p 2141-2157, 1984. 3 Fig, 1 Tab, 10 Ref.

Descriptors: *Cathodic stripping voltammetry, *Voltammetry, *Copper, *Hanging mercury drop electrodes, *Metals, *Water analysis, Catechol, Complexing agents.

Certain metals have been successfully analyzed by cathodic stripping voltammetry (CSV) with concentration of the metal ions onto the surface of solid electrodes by precipitation with complexing agents which form complex ions of low solubility. Trace concentrations of copper (II) in natural water samples were determined by CSV of a film of copper-catechol complex ions adsorbed on a hanging mercury drop electrode (HMDE). Complexation with copper(II) is not selective for copper, but complexes with copper (II) are rather strong; additionally, the reduction potentials of various competing heavy metal ions such as lead (II) and cadmium (II) are well separated from that of copper (II). Addition of a large surplus of catechol (0.0001 to 0.001 M) further ensures that effectively 100% of all copper (II) ions is present in the catechol-complex ion form. After collection the current is measured for the reduction of copper (II) to copper (0) by CVS of the collected film using differential pulse modulation. The peak height of the copper-catechol reduction peak is linearly dependent upon the copper (II) concentration between 10 to the minus 10th and 10 to the minus 7th power M. The detection limit of the technique is below 10 to the minus 10th power M copper (II) for a collection time of 3 minutes, but the sensitivity can be further increased four-fold by collecting for 15 minutes. The sensitivity is reduced by high concentrations of competing trace metals and of surfactants, which necessitate calibration by standard additions to the sample. (Collier-IVI)
W85-04410

EVALUATION TECHNIQUE FOR GROUND WATER QUALITY BENEATH URBAN RUNOFF RETENTION AND PERCOLATION BASINS,
Agricultural Research Service, Fresno, CA. Water Management Research Lab.
For primary bibliographic entry see Field 2G.
W85-04417

GAS CHROMATOGRAPHIC DETERMINATION OF PICLORAM IN FISH,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
A. W. Rieger, D. C. G. Muir, and M. R. Hendzel.
Journal of the Association of Official Analytical Chemists, Vol. 68, No. 1, p 59-61, January/February, 1985. 1 Fig, 3 Tab, 5 Ref.

Descriptors: *Pollutant identification, *Water analysis, *Picloram, Organic compounds, Fish, Chromatography, Herbicides.

Picloram, a widely used herbicide, degrades slowly in soils and water and is mobile in the soil environment because of its high water solubility. Thus it has the potential to contaminate aquatic systems. A method is presented for determining picloram in fish using HCl-ethyl acetate extraction, diazomethane derivatization, Florisil mini-column cleanup, and gas chromatographic (GC) determination. Two different extraction methods are described, one involving acidification and the other without acidification. The detection limit for this method is 5 ng/g, using a 4 g sample. The analysis was quick, simple, and sensitive. A radiotracer study showed that the extraction step was efficient when dealing with fish actually exposed to picloram. (Baker-IVI)
W85-04433

MONITORING OF RIVER WATER QUALITY WITHIN THE GREAT OUSE BASIN USING THE CHIRONOMID EXUVIAL ANALYSIS TECHNIQUE,
Anglian Water Authority, Huntingdon (England).
L. P. Ruse, and R. S. Wilson.
Water Pollution Control, Vol. 83, No. 1, p 116-135, 1984. 16 Fig, 6 Tab, 20 Ref.

Descriptors: *Great Ouse Basin, *England, *Water analysis, *Monitoring, *Midges, Exuvial analysis, Water quality control, Rivers, Pollutant identification.

The ubiquitous nature of chironomids makes the exuvial sampling technique as presented unique in its ability to sample the whole course of a river, and also presents a valuable opportunity for comparing it with currently accepted techniques used by water authorities. The method is useful for deep sluggish stretches difficult to sample adequately by other biological methods. The study was performed where the Bedford Ouse and Ely Ouse rivers merge together to form the Great Ouse basin. The close agreement between observations from the exuvial analysis and expectations from other sources strongly suggests this new method is a reliable source of information, sensitive to short and long-term river quality trends. The analysis may highlight water quality problems not identified with other techniques. (Baker-IVI)
W85-04454

DETERMINATION OF COD BY A MERCURY-FREE OPEN-TUBE METHOD,
Yorkshire Water Authority (England).
K. E. de Casseres, D. G. Best, and B. D. May.
Water Pollution Control, Vol. 83, No. 3, p 416-419, 1984. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Water analysis, *Chemical oxygen demand, Open-tube method, Chlorides, Silver sulfate.

Alternative COD methods have been explored which eliminate the use of mercury salts as chloride suppressants. An open tube method is described which also eliminates mercury sulfate and uses additional silver sulfate to act both as catalyst and chloride suppressant. This modified semi-micro method has been evaluated using standard solutions and real samples both with and without the addition of chloride, and the results are compared with those obtained by the standard SCA reflux method. The proposed method offers substantial savings in chemicals and about a 70% savings in bench space compared with the reflux method, while maintaining acceptable accuracy and precision. The study showed 8% silver sulfate is an effective chloride suppressant and is a suitable substitute for sulfuric acid in COD determinations where the chloride concentration does not exceed 2000 mg/l and the chloride:COD ratio is not greater than 5:1. The method has the added advantage of increased sample throughput and explosion risks are minimal. (Baker-IVI)
W85-04467

VOLATILE ORGANIC POLLUTANTS IN BIOTA AND SEDIMENTS OF LAKE PONTCHARTRAIN,
New Orleans Univ., LA. Center for Bio-Organic Studies.
J. B. Ferrario, G. C. Lawler, I. R. DeLeon, and J. L. Laseter.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 246-266, February, 1985. 4 Tab, 15 Ref. Army Corps of Engineers, Contract DACW29-82-M-0189.

Descriptors: *Lake Pontchartrain, *Louisiana, *Sediments, *Organic compounds, Estuarine biota, Volatile compounds, Halogenated hydrocarbons, Benzene, Toluene, Estuaries, Pollutant identification.

Lake Pontchartrain is a shallow, oligohaline, 1631 sq km estuary located in the deltaic plain of the Mississippi River. The lake serves an adjacent metropolitan area of over 1.5 million people as a major recreational area and as a source of substantial quantities of crabs, shrimps, and other aquatic foods. Samples of oysters, clams, and sediments were collected in May-June, 1980, from the mouths of the Inner Harbor Navigation Canal (IHNC), the Chef Menteur Pass, and The Rigolets, at Lake Pontchartrain. Oysters from the IHNC population contained thirteen specific EPA priority pollutants, of which ten were identified as halogenated with the remainder being benzene and two of its derivatives. The mean concentrations ranged from 0.04 ng/gram wet weight for chlorobenzene to 310 ng/g wet weight for 1,1,1-trichloroethane. The results of the analysis for volatile organic pollutants showed thirteen specific priority pollutants in the analyses with the IHNC samples showing the largest number. Most of the priority pollutants identified are halogenated, with the remaining compounds being benzene and toluene. While the volatile organic priority pollutants found in the biota and sediment samples are of obvious anthropogenic origin, the majority of the other compounds identified are probably biogenic. All the volatile EPA priority polutants identified have possible adverse human health effects including central nervous system depression, narcosis, and various renal and hepatotoxic effects. (Baker-IVI)
W85-04476

IMPORTANCE OF SPECIATION METHODS IN ANALYTICAL CONTROL OF WATER TREATMENT PROCESSES WITH APPLICATION TO FLUORIDE REMOVAL FROM WASTE WATERS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
J. Buffle, N. Parthasarathy, and W. Haerdi.
Water Research, Vol. 19, No. 1, p 7-23, 1985. 12 Fig, 4 Tab, 52 Ref.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Chemical analysis, *Fluoride, *Speciation, Aluminum hydroxide, Coagulation, Ultrafiltration, Filtration, Chemical coagulation, Water anlysis, Spectroscopy.

In many treatment processes, coagulant control is limited just to determination of its optimum dose by the empirical jar-test method which gives no indication of the nature of reactivity of the active species and gives no determination of the forms of the pollutant. Simple methods were developed for control of coagulant reactivity, the products formed, and reactivity of the uneliminated pollutants in the removal of fluoride from aluminum industry wastewater by precipitation with hydrolyzed Al(III) polymer. Fluoride wastes originate from wet scrubbing of emissions from reduction furnaces in which aluminum is separated from bauxite in the presence of cryolite. The wastewater contains the following major constituents with varied concentration depending on the treatment used: F = 50-500 mg/l; SO4 = 0-500 mg/l; Ca = 0-40 mg/l; and 3 < pH < 8. A combination of ultrafiltration with spectroscopic methods and fluoride ion-selective electrode offers a powerful means for the control of both the precipitant and pollutant, e.g. fluoride. Al-27 n.m.r. was used for the identification of hydrolytic products of

aluminum(III) and the ultrafiltration technique was applied for the separation of the active polymer. The hydrolytic products were also characterized by timed spectrometric method. The interaction between aluminum hydroxide polymer and fluoride was studied by means of fluoride ion-selective electrode, ultrafiltration and atomic absorption spectrometry. Using these techniques for determination of optimum conditions for fluoride removal, it was found that the fluoride levels can be brought down to less than 10 mg/l, the limit set by Swiss regulatory body for discharge of waste water. (Collier-IVI)
W85-04485

MEASUREMENT OF PARTICULATE ASSOCIATION OF AMERICIUM IN FRESHWATER,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
N. S. Fisher.
Water Research, Vol. 19, No. 1, p 79-84, 1985. 2 Fig, 4 Tab, 22 Ref.

Descriptors: *Americium, *Particulates, *Complexation, *Radionuclides, Filtration, Metals, Water analysis.

A laboratory investigation tested various filtration methods to study the particulate-water fractionation of Am-241 added to filtered freshwater (Monaco tap water) adjusted to different pH's. By using a system of washed Nuclepore polycarbonate filters, the particulate association (> 0.2 or > 1 micro m) was found to increase hyperbolically with pH and with time, so that less than 1% of the Am was filterable (i.e. retained by a filter) at pH 4.2 and about 5% was filterable at pH 8.2 after 1 day; light had no apparent effect on the filterability of the Am. These values are somewhat greater than those for particle association of Am in seawater but substantially lower than previous estimates of Am particulate association in filtered freshwater. Filter adsorption problems are identified for other filtration systems commonly employed to assess metal particulate association. The results suggest that Am in freshwater is unlikely to form particles to an appreciable extent at pH's < or = 8. (Author's abstract)
W85-04491

COMPARISON OF CURRENT METHODS OF POLIOVIRUS CONCENTRATION FROM TAP WATER,
Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
For primary bibliographic entry see Field 5F.
W85-04492

DETERMINATION OF TRIALKYL AND TRIARYL PHOSPHATES IN ENVIRONMENTAL SAMPLES,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
For primary bibliographic entry see Field 5B.
W85-04497

DIFFERENT APPROACH TO WATER QUALITY SAMPLING,
Wessex Water Authority, Poole (England).
M. P. Brown, and D. P. Outtram.
Water Pollution Control, Vol. 82, No. 3, p 309-314, 1983. 2 Tab.

Descriptors: *Water quality control, *Sampling, Somerset River, England, Water quality, Computers, Monitoring.

A random sampling program project was undertaken to produce better information on the quality of river waters and discharges with the existing number of samples taken from the Somerset River. Composite river maps were prepared from samples taken and used to prepare graded river maps. With reference to the grade river maps the overall sampling requirement for the division was deduced by applying certain rules. A crossroad has now been reached in the development of the sampling program. The fully computerized scheme could be pursued, the existing program (suitably enhanced to take account of some of the shortfalls) could be continued or the whole scheme abandoned in favor or the original approach to sampling or another new approach. At present a regional sampling scheme is being developed, and the implications of this upon the agency sampling program have not yet been fully evaluated. (Baker-IVI)
W85-04524

EVALUATION OF ACIDIFICATION BASED ON FORMER COLORIMETRIC DETERMINATION OF PH: THE EFFECT OF INDICATORS ON PH IN POORLY BUFFERED WATER,
Oslo Univ. (Norway). Dept. of Limnology.
I. A. Blakar, and I. Digernes.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 679-685, October, 1984. 4 Fig, 2 Tab, 20 Ref.

Descriptors: *Colorimetry, *Acidification, *Indicators, *Hydrogen ion concentration, Buffering, Water analysis.

The effect of indicators on pH in unbuffered water are examined and the use of the former colorimetric pH-data to quantify changes in pH over time is discussed. Indicator solutions did not influence pH of strongly buffered solutions, but unbuffered water was affected to a varying degree. In parts of their working range the indicators had little effect on pH, but could show considerable deviation in others. An example is given of how pH in different unbuffered water samples measured to 5.3, 6.6, and 8.3 with pH-meter, could all be read to 6.6 colorimetrically depending on the indicator used. Correspondingly unbuffered water with pH 5.4 could be measured to pH 4.8, 5.4, 5.9, or 8.3 depending on which indicators were used. All the effects were within the standard working ranges of the indicators used. Methylred (4.4 to 6.0) and methylorange (2.8 to 4.4) were the only indicators giving relatively accurate pH-determinations. Other indicators evaluated included bromcresolgreen, bromcresolpurple, dibromred, bromophenolred, bromthymolblue, phenolred, and cresolred. Ideally, the indicator solution added should have the same pH as the sample, but this would make measurements very laborious and complicated. The pH-meter readings of unbuffered water changed less than 0.05 pH-units when any of the indicators tested were added in higher dilution (1:400). (Baker-IVI)
W85-04530

METALS AND SYNTHETIC ORGANIC COMPOUNDS IN PLANKTON FROM THE ESTUARY AND HARBOR AREA IN OSAKA CITY,
Osaka City Inst. of Public Health and Environmental Sciences (Japan).
S. Kawai, M. Fukushima, T. Tsuchinaga, and K. Oda.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No. 10, p 1777-1783, October, 1984. 4 Fig, 5 Tab, 16 Ref.

Descriptors: *Plankton, *Monitoring, *Pollutant identification, *Heavy metals, *Organic compounds, Osaka, Japan, Chlorinated hydrocarbons, Organophosphorus compounds, Biological magnification, Estuaries, Harbors.

This study was made in order to evaluate the feasibility of net plankton analysis for monitoring pollution due to heavy metals and synthetic chemicals in seawater. Plankton was collected by using a phytoplankton net in the harbor area of Osaka City, Japan. Heavy metals, organochlorine and organophosphorus compounds in the net plankton and also in the corresponding seawater were determined. The heavy metal concentration in the seawater increased in the order of, HG < Cd < Pb < Cu, Cr < Ni < Zn < Mn < Fe. In the net plankton, the order was as follows; Hg < Cd < Ni, Cr, Pb < Cu, Mn < Zn < Fe. Except for Ni and Mn, the metal levels in the net plankton corresponded to those in the seawater, and their bioconcentration factors (BCF) were 10,000 to 50,000 but in Ni and Mn the factors were 4,000 to 5,000. Organochlorine compounds such a PCBs and HCH were clearly noticed in the net plankton and the levels ranged from 1 to 5 micro-g/g and from 0.1 to 0.2 micro-g/g in dry basis, respectively. These values were entirely dependent on the seawater levels and the BCF of PCBs was 11,000 and 4,000 in HCH. Organophosphorus pesticides including diazinon, IBP (s-benzyl diisopropyl phosphorothionate) and fenitrothion were almost always found in the seawater. These compounds, however, were never detected in the net plankton. These results indicate the feasibility of plankton analysis for monitoring approximate pollution in water, but some problems observed in certain metals and organophosphorus compounds still remain to be studied. (Author's abstract)
W85-04607

COMPARISON OF THE SELENASTRUM BOTTLE TEST AND THE NATURAL PHYTOPLANKTON ASSAY IN ALGAL TOXICITY TESTS,
Jyvaeskylae Univ. (Finland). Dept. of Biology.
V. A. Eloranta, and L. Halttunen-Keyrilainen.
Archiv fur Hydrobiologie Supplement, Vol. 67, No. 4, p 447-459, December, 1984. 4 Fig, 4 Tab, 23 Ref.

Descriptors: *Pulp wastes, *Toxicity, *Phytoplankton, *Selenastrum bottle test, Kraft mills, Carbon radioisotopes, Effluents, Industrial wastes, Algae, Algal growth.

Acute toxicity of three effluents from a bleached kraft pulp mill was studied on algal growth and C-14 fixation with Selenastrum bottle test and natural phytoplankton assay. The effluents used were the C-stage and the E-stage effluents, and the whole effluent, BKME. The main purpose of this study was to compare the results between the single-species test (a screening test) and the natural phytoplankton community assay, and to evaluate the usefulness of these tests. Chemical properties of test solutions (e.g. pH, buffering capacity, nutrients) affected the acute toxicity of the effluents more than test algae. Algal responses measured by two different methods might remarkably differ because of dark color of the effluent. According to the standardized test, Selenastrum was most sensitive to the effluents. However, in lake water tests Selenastrum was less sensitive than natural phytoplankton after the EC50 (2 + 4 h) values. The phytoplankton assay might also show another kind of sensitivity, to show secondarily stimulative effects of the effluents. (Author's abstract)
W85-04615

PRECONCENTRATION OF SUBMICROGRAM AMOUNTS OF METALS FROM NATURAL WATERS FOR X-RAY ENERGY SPECTROMETRIC DETERMINATION USING PYRROLIDINECARBODITHIOIC ACID,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
T. Tisue, C. Seils, and R. T. Keel.
Analytical Chemistry, Vol. 57, No. 1, p 82-87, January, 1985. 5 Fig, 4 Tab, 24 Ref.

Descriptors: *Trace metals, *Spectrometry, Natural waters, X-ray energy spectrometry, Preconcentration, Water analysis, Metals.

A method was developed for the routine determination of several trace metals in natural waters by X-ray energy spectrometry following precipitation with pyrrolidinecarbodithioate. Preoxidation with persulfate eliminates interferences by organic matter. By optimizing carrier ion selection and measurement conditions, one may determine dithioate-reactive elements with Z < or = 50 by means of their K X-rays, and some with Z > or = 80 by means of their L X-rays. Determinations are feasible for several elements at concentrations down to 250 ng/L, or below. Recoveries are generally greater than 90%, although some exceptions are noted. Reproducibility with real samples averaged about 25% relative standard deviation for five representative elements at concentrations above 250 ng/L. (Author's abstract)
W85-04621

TRACE DETERMINATION OF ALDEHYDES IN WATER BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Osaka Prefecture Environmental Pollution Control Center (Japan).
K. Takami, K. Kuwata, A. Sugimae, and M. Nakamoto.
Analytical Chemistry, Vol. 57, No. 1, p 243-245, January, 1985. 4 Fig, 4 Tab, 8 Ref.

Descriptors: *Aldehydes, *High-performance liquid chromatography, Alphatic compounds, Aromatic compounds, Cation exchange, Sampling, Acetaldehyde, Propionaldehyde, Benzaldehyde.

A liquid chromatographic method is presented to determine trace amounts of aliphatic and aromatic aldehydes in water by using an innovative sampling cartridge. The PTFE cartridge used was packed with a moderately sulfonated cation exchange resin charged with 2,4-dinitrophenylhydrazine. A 20-500-mL volume of water sample was passed through the cartridge. The 2,4-dinitrophenylhydrazone derivatives of the aldehydes on the resin were selectively eluted with acetonitrile. The eluate was analyzed by high-performance liquid chromatography with a 3-micro-m ODS column. With a 500-mL water sample, the detection limits were 0.6 micro g/L for formaldehyde and 0.3 micro-g/L for acetaldehyde, propionaldehyde, and benzaldehyde. The aldehydes could be determined with 1.7-3.7% relative standard deviation in the range 1-10 micro-g/L. (Author's abstract)
W85-04622

SIMULTANEOUS DETERMINATION OF ZINC AND CHROMATE IN COOLING WATER BY DIFFERENTIAL PULSE POLAROGRAPHY,
Projects and Development India Ltd., Sindri (India). Chemical Research Wing.
V. K. Jindal, M. A. Kham, R. M. Bhatnagar, and S. Varma.
Analytical Chemistry, Vol. 57, No. 1, p 308-383, January, 1985. 4 Fig, 5 Tab, 10 Ref.

Descriptors: *Polarography, *Zinc, *Chromates, *Cooling water, Pollutant identification, Phosphates, Chromates, Differential pulse polarography, Water analysis.

The use of differential pulse polarography (DPP) for the simultaneous determination of zinc and chromate in cooling water is reported where zinc (5 ppm), chromate (20 ppm), and polyphosphate (50 ppm) formulation is used as a corrosion inhibitor. This will help in effective control of cooling tower performance. In addition to calcium ions, other ions that are likely to be present and interfere with the determination of zinc and chromate ions by DPP are sulfate, chloride, nitrite and nitrate, and these occur in significant amounts in the cooling and process water. The DPP method has been applied for the simultaneous determination of zinc and chromate ions in process and cooling water samples from fertilizer plants in India. The method is based on the reduction of Cr and Zn on SMDE in 1 M NH3-0.1 M NH4Cl and 0.005% gelatine supporting electrolyte. Due to interference it is essential to complex calcium ions by adding polyphosphate and to destroy NO2(-)/NO3(-) by adding sulfamic acid along with hydrochloric acid before the actual recording of DP polarograms. The present DP polarographic method for the simultaneous determination zinc and chromate is comparable in its utility and applicability with spectrophotometric methods. The method has a better accuracy and higher sensitivity and is quick, as both of the ions can be determined in a single scan. (Baker-IVI)
W85-04624

DETERMINATION OF MICROBIAL CELL NUMBERS IN SUBSURFACE SAMPLES,
Oklahoma State Univ., Stillwater. Dept. of Biochemistry.
J. J. Webster, G. J. Hampton, J. T. Wilson, W. C. Ghiorse, and F. R. Leach.
Ground Water, Vol. 23, No. 1, p 17-25, January-February, 1985. 2 Fig, 3 Tab, 34 Ref.

Descriptors: *Microorganisms, *Subsurface material, *Bacterial analysis, Metabolic activity, ATP, Microbiological studies.

Because the transport and fate of the organic pollutants may be influenced by microorganisms present in subsurface material, reliable measurements of the number of organisms in subsurface samples and their metabolic activity are needed. A special drilling rig and aseptic procedures were used to yield uncontaminated subsurface samples. The number of bacteria in subsurface samples was determined by microscopic counting after acridine orange staining; the proportion of cells capable of respiration was determined by INT reduction. An independent measure of metabolic activity was obtained by measuring ATP extracted from the samples. A procedure and extractant for the extraction of ATP from subsurface material were developed. The extractant contains reagents to reduce the loss of the extracted ATP. Subsurface samples from Oklahoma and Texas contain 10 to the 6th to 10 to the 7th cells per g of subsurface material (depths of 2-9 m). Between 1 and 10% of the cells were metabolically active. When the two methods are employed together, a more complete picture of the potential metabolic activity can be obtained. When coupled with existing microcosm data, these methods can reduce the expense and time for predicting the behavior of pollutants in subsurface environments. (Moore-IVI)
W85-04636

NITROGEN-ISOTOPE RATIOS OF NITRATE IN GROUND WATER UNDER FERTILIZED FIELDS, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5B.
W85-04641

DETERMINATION OF TRACE AMOUNTS OF HEAVY METALS IN WATERS BY A FLOW-INJECTION SYSTEM INCLUDING ION-EXCHANGE PRECONCENTRATION AND FLAME ATOMIC ABSORPTION SPECTROMETRIC DETECTION,
Academia Sinica, Shenyang (China). Inst. of Forestry and Soil Science.
Z. Fang, S. Xu, and S. Zhang.
Analytical Chimica Acta, Vol. 164, p 41-50, October, 1984. 6 Fig, 2 Tab, 10 Ref.

Descriptors: *Atomic absorption spectrometry, *Flow-injection analysis, *Ion exchange, *Heavy metals, Nickel, Copper, Lead, Cadmium, Metals, Pollutant identification,.

A flow-injection system with ion-exchange preconcentration and atomic absorption detection has been developed and applied to the determination of trace amounts of heavy metals in some natural waters. A multifunctional rotary valve, incorporating two parallel miniature ion exchange columns packed with a chelating resin with salicylic acid functional groups was used for sequential sampling, injection, ion exchange and elution. A 20-28 fold increase in sensitivity compared to direct aspiration of sample was obtained for nickel, copper, lead, and cadmium at a sampling rate of 40/hr and 40-50 fold enhancements were possible at samping rates of 20/hr. (Baker-IVI)
W85-04653

APPLICATION OF ION-EXCHANGE CHROMATOGRAPHY WITH AN ION-SELECTIVE ELECTRODE DETECTOR TO IODINE DETERMINATION IN NATURAL WATERS,
National Research Council of Canada, Halifax (Nova Scotia). Atlantic Research Lab.
E. C. V. Butler, and R. M. Gershey.
Analytica Chimica Acta, Vol. 164, p 153-161, October, 1984. 6 Fig, 24 Ref.

Descriptors: *Ion exchange chromatography, *Iodine, *Pollutant identification, *Ion selective electrode, Water analysis, Potentiometry, Natural waters, Seawater, Iodides.

The use of an iodide-ion selective electrode to measure iodide separated from other anions in fresh waters and sea water by ion exchange high pressure liquid chromatograpy is described. For efficient operation of the detector, a background level of iodide is diffused into the column effluent just upstream of the detector. This feature enables on-line preconcentration of iodide on an anion guard cartridge. For sea water, it is advantageous to determine iodide directly and to quantify iodate as the difference between total iodine and iodide. The direct determination of iodide in a coastal sea water and the quantitation of other iodine species after simple chemical pretreatment are described. (Baker-IVI)
W85-04654

SAMPLING TUBING EFFECTS ON GROUNDWATER SAMPLES,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
For primary bibliographic entry see Field 7B.
W85-04655

SCHEME FOR THE DIRECT ANALYSIS OF ORGANICS IN THE ENVIRONMENT BY TANDEM MASS SPECTROMETRY,
Virginia Univ., Charlottesville. Dept. of Chemistry.
D. F. Hunt, J. Shabanowitz, T. M. Harvey, and M. Coates.
Analytical Chemistry, Vol. 57, p 525-537, February, 1985. 1 Fig, 8 Tab, 15 Ref.

Descriptors: *Tandem mass spectrometry, *Pollutant identification, *Water analysis, Mass spectrometry, Organic compounds.

An alternative system for the direct analysis of organics in the environment is presented which is based on tandem mass spectrometry that overcomes many of the limitations inherent in the gas chromatography/mass spectrometry methodology. The method employs the technique of collision activated dissociation on a triple quadrupole mass spectrometer and facilitates direct, rapid qualitative semiquantitative analysis of organics in both liquid and solid environmental matrices at the 10-100 ppb level. Elimination of most, if not all, wet chemical and chromatographic separation steps, detection of both known and unknown by molecular weight and functional group, and a total analysis time per sample of under 30 min are additional features of the tandem mass spectrometry method. (Baker-IVI)
W85-04656

USE OF BACTERIOLOGICAL INDICATORS FOR SWIMMING WATER QUALITY,
Gore and Storrie Ltd., Toronto (Ontario).
M. D. Palmer, J. D. Lock, and T. P. H. Gowda.
Water and Pollution Cotrol, Vol. 122, No. 3, p 14-15, 17-18, 74, May/June, 1984. 1 Fig, 2 Tab.

Descriptors: *Water quality, *Bacteria analysis, *Indicator organisms, *Swimming, Recreation, Water management, Coliforms, Bacteria, Sampling, Beaches.

For an indicator bacteria to be a reliable measure of water quality they should be associated with the source of pathogens; be able to provide an accurate estimate of the number of pathogens present at the levels which pose a health risk; have the same environmental survival characteristics of the most resistant pathogen possibly present; and be measurable by simple methods with considerable accuracy. The use of fecal coliforms as an indicator requires a relationship between the coliforms and pathogens. Enterococci have proved to be extremely useful as they were found to be more consistently related to fecal wastes than the other indicators; their densities did not increase during treatment of the wastewaters; they do not multiply after leaving the intestinal tract; they survive better in the environment than coliforms and enteroviruses; and they seem to better simulate viral pathogens with regard to chlorine sensitivity. It is general practice that a geometric mean value of a number of samples should be used as a measure of the bacteria to reduce the impact of single abnor-

mally high values. How many samples are required for a representative geometric mean value is of major concern. The sampling program should be developed for a particular beach to reflect the characteristics and use of that beach. For some beaches other secondary indicators can be used to indicate elevated levels of bacteria. Health authorities will have to establish the level of acceptable risk for any particular beach. (Baker-IVI)
W85-04765

VOLTAMMETRIC METHODS FOR DISTINGUISHING BETWEEN DISSOLVED AND PARTICULATE METAL ION CONCENTRATIONS IN THE PRESENCE OF HYDROUS OXIDES. A CASE STUDY ON LEAD (II),
Technical Univ. of Lisbon (Portugal). Inst. Superior Tecnico.
M. de L. S. Goncalves, L. Sigg, and W. Stumm.
Environmental Science and Technology, Vol. 19, No. 2, p 141-146, 1985. 4 Fig, 2 Tab, 29 Ref.

Descriptors: *Lead, *Voltammetry, *Dissolved solids, *Particulate matter, Oxides, Colloids, Polarography, Pollutant identification, Iron oxide hydroxide, Manganese dioxide, Silicon dioxide, Metals.

Voltammetric techniques (differential pulse polarography, DPP, anodic stripping voltammetry, ASV, and differential pulse anodic stripping voltammetry, DPASV) were evaluated for their capability to distinguish between dissolved and particulate Pb(II) concentrations. Colloids of FeOOH, MnO2, and SiO2 were found to have no effect on the electrochemical reversibility (peak width, peak potential and pseudopolarographic half-wave potential) of the Pb(II) reduction system. Soluble Pb(II) concentrations measured in the presence of colloids were consistent and independent of the voltammetric method used and the different time scales employed in these techniques. Equilibrium constants for the specific adsorption of Pb(2+) on FeOOH, MnO2, and SiO2 surfaces were determined. Applicability of voltammetric techniques to other metals and in the presence of other colloids and in natural waters is discussed. (Author's abstract)
W85-04800

DETERMINATION OF SPREADING OF NUTRITIVE SALTS IN QUASI-STAGNANT WATERS BY USING LITHIUM (CHLORIDE) AS TRACER AND CONTINUOUS MEASUREMENT OF WATER-QUALITY PARAMETERS (DIE BESTIMMUNG VON AUSBREITUNGSVORGANGEN VON NAHRSALZEN IN QUASI STEHENDEN GEWASSERN UNTER VERWENDUNG DES TRACERS LITHIUM (CHLORID) UND DIE KONTINUIERLICHE MESSUNG VON WASSERGUTEPARAMETERN),
Neandestre. 23, 1000 Berlin 49.
H. Kaldenhoff.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 4, p 118-122, October, 1984. 8 Fig.

Descriptors: *Tracers, *Lithium chloride, *Water quality, *Nutrients, Sampling, Data analysis, Stagnant water, Solute transport, Diffusion.

A measuring system was developed to determine the spreading of nutritive salts in quasi-stagnant waters. Lithium chloride was used as a tracer. The system is installed on board a boat and consists of an injection appliance for producing the tracer cloud, a sampling system for taking water samples continuously from different depths, a flame spectrometer for in-situ sample analysis, a data logger and a software package for data analysis. The tracer concentration in each zone of measurement can be plotted in the form of an isogram or a three-dimensional graph to show the spreading and movement as a function of time and depth. the system is also suited, using analogous probes, to measure water quality parameters, such as oxygen concentration, pH, temperature, conductivity and metal ions. These data are then evaluated and plotted in the same way as the tracer concentration. (Moore-IVI)
W85-04810

SPECIFIC ULTRAVIOLET ABSORBANCE BAND OF MICROCYSTIS AERUGINOSA TOXINS,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Botany.
J. N. Eloff.
Journal of the Limnological Society of South Africa, Vol. 8, No. 1, p 5-7, 1982. 3 Fig, 11 Ref.

Descriptors: *Ultraviolet absorption, *Microcystis, *Toxins, Cyanophyta, Toxicity, Eutrophication.

Microcystis aeruginosa is a cosmopolitan cyanobacterium frequently responsible for freshwater algal blooms in eutrophied impoundments. The blooms result in serious water management problems. Toxic fractions of Microcystis aeruginosa extracts were always associated with a 240-nm absorbance band. The ratio of the absorbance at 240 nm to other wavelengths can provide a measure of toxin purity during isolation. Mouse toxicity assay which is a relatively tedious and time-consuming procedure if accurate toxicity estimates are required, have always been used to detect toxic fractions. The M. aeruginosa toxins were ninhydrin-negative before hydrolysis and lacked visible fluorescence. Their 240-nm absorbance is of value in the isolation of the toxin. Monitoring the eluates from column chromatographic separations at 240 and 210 nm identified toxic fractions in all of the M. aeruginosa extracts examined because only toxic fractions have higher absorbance at 240 than at 210 nm. (Baker-IVI)
W85-04816

SEWAGE-DERIVED BACTERIA MONITORED IN A MARINE WATER COLUMN BY MEANS OF CAPTIVE MUSSELS,
University Coll. of Swansea (Wales). Dept. of Botany and Microbiology.
D. R. Trollope, and S. B. S. Al-salihi.
Marine Environmental Research, Vol. 12, No. 4, p 311-322, 1984. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Bacteria, *Mussels, *Monitoring, *Wastewater pollution, Escherichia, Streptococcus, Fecal coliforms, Marine environment, Tidal effects, Bacterial analysis.

Batches of mussels, Mytilus edulis, obtained from a sewage-free shore were introduced into the water column at a sewage polluted site and the changed content (Escherichia coli, fecal streptococci) was assessed after immersion periods of 2 to 40 h. Rapid bacterial uptake was demonstrated; changes were analyzed with respect to immersion period, revealing that 2 h was satisfactory. The numbers of bacteria varied with height in the water column; mussels for the sea bed contained higher numbers of E. coli than mussels immersed just below the surface except for mussels withdrawn at, and for about 3 h after, low water (LW). These observations were shown to be related to the characteristics of the effluent and tidal systems operative at the site. (Moore-IVI)
W85-04868

EMBRYO ABNORMALITIES IN THE PERIWINKLE, LITTORINA 'SAXATILIS', AS INDICATORS OF STRESS IN POLLUTED MARINE ENVIRONMENTS,
Institute for Marine Environmental Research, Plymouth (England).
D. R. Dixon, and D. Pollard.
Marine Pollution Bulletin, Vol. 16, No. 1, p 29-33, January, 1985. 3 Fig, 30 Ref.

Descriptors: *Periwinkles, *Bioindicators, *Marine environment, *Wales, Embryonic growth stage, Water pollution effects, Water quality, Pathology, Gastropods.

Brood pouches of periwinkles belonging to the Littorina 'saxatilis' species complex usually contain, in addition to the five normal stages in development, a proportion of embryos that are morphologically abnormal. The frequency of adults with a high percentage of abnormals in their brood pouches reflects to a great extent the degree of environmental stress, natural and anthropogenic, to which the adult population has been exposed. Collections of this gastropod from coastal populations along the Gower coast, in South Wales, disclosed higher frequencies of abnormal embryos from sites exposed to pollutant-laden, residual water currents in Swansea Bay, than was recorded from a clean, coastal population at Rhossili, 26 km west of Swansea, where frequencies were similar to those recorded from other unpolluted, coastal populations elsewhere in the British Isles. While environmental water quality is probably a dominating factor in determining this effect, the presence of a low frequency of high scoring individuals in clean environments points to this phenomenon having a complex etiology. It is suggested that the underlying causal factor may be one of disease, which is present in all L. 'saxatilis' populations, and which is triggered by factors related to reduced environmental water quality. (Author's abstract)
W85-04893

RETRIEVAL OF MATERIAL FROM THE SURFACE MICROLAYER WITH SCREEN AND PLATE SAMPLERS AND ITS IMPLICATIONS FOR PARTITIONING OF MATERIAL WITHIN THE MICROLAYER,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
K. W. Estep, J. S. Maki, S. C. Danos, and C. C. Remsen.
Freshwater Biology, Vol. 15, No. 1, p 15-19, February, 1985. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Air-water interfaces, *Surface microlayers, *Sampling, Particulate matter, Dissolved solids, Algae, Surface tension.

Unique physical, chemical and biological conditions exist at the air-water interface. Visible slicks often form a surface film. In addition to this surface monolayer there is an associated layer of undetermined thickness in which dissolved material and organisms are often concentrated. Surface microlayer samples were collected from two small experimental ponds in Wisconsin from June 1978 to November 1980, using screen and plate samplers. These devices performed identically for dissolved substances but for particulate material the glass plate sampler produced values 4 times those obtained with the screen. Differences in sampling efficiency are probably the result of the failure of the screen sampler to release all of the particulate material it has collected. Macroscopic algal filaments are often trapped on the screen during draining. Particulates are most likely to be concentrated at the surface monolayer by virtue of adherence to the surface tension and would be more efficiently sampled by the plate which picks up less subsurface water. There may be a four-fold dilution with subsurface water in the screen samples when compared to the plate samples. Dissolved material is concentrated in a thicker layer below the surface monolayer, resulting in equal sampling efficiency with the plate and screen samplers. The surface microlayer of nutrient-rich waters should not be thought of as only a surface monolayer of hydrophobic material but as a complex of a surface active monolayer with associated particulates and a thicker layer of dissolved material. (Moore-IVI)
W85-04895

EFFECTS OF PHOSPHORUS AND NITROGEN ENRICHMENT ON THE YIELD OF SOME STRAINS OF STIGEOCLONIUM, KUTZ. (CHLOROPHYCEAE),
Vrije Univ., Amsterdam (Netherlands). Biological Lab.
P. J. R. de Vries, S. J. M. de Smet, and J. van der Heide.
Freshwater Biology, Vol. 15, No. 1, p 95-103, February, 1985. 4 Fig, 1 Tab, 18 Ref.

Descriptors: *Phosphorus, *Nitrogen, *Algal growth, *Eutrophication, *Bioassay, Limiting nutrients, Mathematical models, Water pollution effects.

In the Netherlands, in most agricultural areas extensive growth of macrophytes and algae in polder ditches is caused by high nutrient loads of both nitrogen and phosphorus. Algal bioassays are a

suitable tool for monitoring eutrophication. A bioassay procedure was applied to demonstrate the interaction between phosphorus and nitrogen in determining the yield of selected strains of Stigeoclonium in a synthetic medium as well as in natural waters. Increase of yield after addition of one nutrient depends on the concentration of the other. A graphic growth model based on the experiments in synthetic medium allows prediction of yields at different combinations of nitrate and phosphorus concentrations. In general, yields in natural waters before and after addition of nitrate and/or phosphate agree with the model. In some cases, other limiting factors appear to be involved. Apparently, prediction cannot be based on a simple determination of only a few nutrient concentrations at the sampling site. Bioassays should also be made to detect the possible interaction of other factors. Neither an exponential model (Baule-Mitscherlich) nor a hyperbolic model adequately describe the interaction demonstrated between nitrogen and phosphorus limitation. (Moore-IVI)
W85-04898

CAPILLARY GAS CHROMATOGRAPHY DETERMINATION OF VOLATILE ORGANIC ACIDS IN RAIN AND FOG SAMPLES,
California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
K. Kawamura, and I. R. Kaplan.
Analytical Chemistry, Vol. 56, No. 9, p 1616-1620, August, 1984. 6 Fig, 2 Tab, 12 Ref.

Descriptors: *Gas chromatography, *Organic compounds, *Volatile acids, *Pollutant identification, Rain, Fog, Water analysis.

A sensitive method for measuring volatile acid (C1-C7) in rain and fog samples as their p-bromophenacyl esters, using a high-resolution capillary gas chromatograph employing fused silca columns is presented. The purification of the esters was performed on silica gel columns prior to GC analysis. The authenticity of the esters was verified by GC/MS. Due to its high sensitivity, the capillary GC/FD method has great advantages for measuring face amounts of volatile acids in environmental samples. Although simpler to perform, ion chromatography is less sensitive and in practical terms is limited to detection of formic and acetic monocarboxylic acids only. Phenacyl esters of the volatile acids can be easily identified by their characteristic fragmentation patterns using GC/MS. (Baker-IVI)
W85-04959

USE OF A PERMEATION SAMPLER FOR DETERMINATION OF VOLATILE PRIORITY POLLUTANTS,
Akron Univ., OH. Dept. of Chemistry.
R. D. Blanchard, and J. K. Hardy.
Analytical Chemistry, Vol. 56, No. 9, p 1621-1624, August, 1985. 4 Fig, 5 Tab, 14 Ref.

Descriptors: *Sampling, *Permeation samplers, *Volatile compounds, *Priority Pollutants, Water analysis, Gas chromatography, Pollutant identification, Organic compounds.

A method for the sampling and subsequent analysis of six volatile organic Priority Pollutants is described. Samples are collected by permeation through a silicone polycarbonate membrane and adsorbed onto activated charcoal. Analysis consists of sample desorption and quantitative measurement by gas chromatography. Linearity is obtained between the mass of analyte collected and the product of the external concentration of analyte and the time of exposure, with linearity observed from low parts per billion to mid parts per million. This method has the advantages of providing time-weighted-average concentration values, stabilizing the collected sample, requiring no power, and being simple and inexpensive to use. The device response time is less than 5 min for each compound. No significant interferences are observed but response is temperature dependent. Precision and accuracy are comparable to presently accepted methods of collection and analysis. (Author's abstract)
W85-04960

DITHIOCARBAMATE EXTRACTION OF GALLIUM FROM NATURAL WATERS AND FROM BIOLOGICAL SAMPLES FOR NEUTRON ACTIVATION ANALYSIS,
Idaho Univ., Moscow. Dept. of Chemistry.
J. C. Yu, and C. M. Wai.
Analytical Chemistry, Vol. 56, No. 9, p 1689-1691, August, 1985. 1 Fig, 21 Ref.

Descriptors: *Gallium, *Neutron activation analysis, *Extraction, Natural waters, Water analysis, Pollutant identification, Metals.

Traces of gallium in aqueous solution can be extracted with a mixture of pyrrolidinecarbodithioate and diethyldithiocarbamate in the pH range 4-6 into chloroform. Gallium in the organic phase can be back-extracted into the aqueous phase with a lead nitrate solution for neutron activation analysis (NAA). This two-step extraction process provides a large preconcentration factor for gallium and eliminates potential interferences from the matrix species and other metals present in natural water and biological samples. Because lead is insensitive to NAA, its presence in the final solution does not cause any interferences for gallium determination. By use of this extraction method and NAA, a detection limit of 10-3 micro-g/L gallium in water can be achieved. (Author's abstract)
W85-04961

5B. Sources Of Pollution

TRACE METAL RESIDUES IN SHELLFISH FROM MARYLAND WATERS, 1976-1980,
Maryland Dept. of Health and Mental Hygiene, Baltimore.
M. Eisenberg, and J. J. Topping.
Journal of Environmental Science and Health, Vol. B19, No. 7, p 649-671, October, 1984. 1 Fig, 3 Tab, 22 Ref.

Descriptors: *Trace metals, *Shellfish, *Maryland, Arsenic, Cadmium, Chromium, Copper, Lead, Mercury, Zinc, Oysters, Clams, Crabs, Heavy metals.

Levels of seven heavy metal residues, arsenic, cadmium, chromium, copper, lead, mercury and zinc were monitored in samples of the American oyster (Crassostrea virginica), the soft shell clam (Mya arenaria), the hard shell clam (Mercenaria mercenaria) and the blue crab (Callinectes sapidus). The study was conducted from 1976 through 1980. In cases where the Food and Drug Administration has established action levels, mean and median yearly values were significantly below these levels. In cases where no action level exists, heavy metal residues in the shellfish samples were well below levels which are generally regarded as safe. No significant yearly trends in heavy metal residues were discovered. Apparent increases in arsenic levels merit further study. (Baker-IVI)
W85-04436

ORGANOCHLORINE RESIDUES IN SHELLFISH FROM MARYLAND WATERS, 1976-1980,
Maryland Dept. of Health and Mental Hygiene, Baltimore.
M. Eisenberg, and J. J. Topping.
Journal of Environmental Science and Health, Vol. B19, No. 7, p 673-688, October, 1984. 3 Tab, 12 Ref.

Descriptors: *Shellfish, *Chlorinated hydrocarbons, *Fate of pollutants, *Maryland, Organic compounds, Oysters, Clams, Crabs, Chesapeake Bay, Polychlorinated biphenyls, Monitoring.

Samples of the American oyster (Crassostrea virginica), the hard shelled clam (Mercenaria mercenaria), the soft shelled clam (Mya arenaria) and the blue crab (Callinectes sapicus) were sampled from the Maryland waters of the Chespeake Bay and its tributaries. These samples were analyzed for as many as 18 organochlorine compounds considered to be toxic substances. This study encompassed the period from 1976 to 1980. In cases where action levels have been established by the Food and Drug Administration, mean and median yearly values fall considerably below these levels. In cases where no action level exists, organochlorine residues in the shellfish samples were well below levels which are generally regarded as safe. (Baker-IVI)
W85-04437

ORGANOCHLORINE INSECTICIDES AND PCBS IN WATER, SEDIMENT, AND FISH FROM THE MEDITERRANEAN SEA,
National Research Centre, Cairo (Egypt). Water Pollution Control Lab.
M. A. El-Dib, and M. I. Badawy.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 216-227, February, 1985. 1 Fig, 5 Tab, 12 Ref.

Descriptors: *Mediterranean Sea, *Insecticides, *Polychlorinated biphenyls, Organic compounds, Fish, Sediments, Water analysis, Seawater, Aldrin, Endrin, DDT, Lindane, HCB, Chlordane, Pesticide residues.

In Egypt and some other Mediterranean countries, wastewaters are discharged into the sea directly, or via agricultural drains. The prevailing levels of organochlorine insecticides and PCBs are assessed in the sea water, sediments and some fish species collected at Port-Said. Aldrin, endrin, dieldrin and o,p-DDT were not detected in any of the water samples investigated. HCB and lindane residues were always very low compared with the other isolated organochlorine insecticides. Chlordane was identified in most water samples and its concentration ranged between 0.1 and 92.9 ng/L. PCBs were identified in all water samples investigated but its concentration was subject to material changes. The mean of residue levels of PCBs in water during September 1982, April, June, and September 1983 were 94, 41, 105, and 19 ng/L, respectively. The concentration of total p,p'-DDT tends to equal or exceed that of PCBs during September 1982 and April 1983. PCBs were always present in sediment samples as was the case with water samples. The distribution and concentration levels of organochlorine insecticides and PCBs in fish species investigated are listed. p,p'-DDT and its metabolites were the most frequently distributed insecticides in the fish studied and presented the highest residues compared to other insecticides. (Baker-IVI)
W85-04473

DETERMINATION OF POLYAROMATIC HYDROCARBONS IN SCALLOPS (PECTEN MAXIMUS) BY UV FLUORESCENCE AND HPLC COMBINED WITH UV AND FLUORESCENCE DETECTORS,
Centre National de la Recherche Scientifique, Brest (France). Lab. de Chromatographie.
M. P. Friocourt, G. Bodennec, and F. Berthou.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 228-238, February, 1985. 5 Fig, 4 Tab, 17 Ref.

Descriptors: *Bioindicators, *Monitoring, *Scallops, *Polyaromatic hydrocarbons, Fluorescence, Chromatography, Aliphatic compounds, Aromatic hydrocarbons, Water pollution sources, Oil spills.

Information is provided on the level of hydrocarbon pollution in scallop breeding areas in an attempt to use these organisms as biomonitors. In a first approximation the levels of polyaromatic hydrcarbons (PAH) in gonads were nearly twofold that observed in muscles: 8.6 vs 4.0. This result was expected as the lipid content is higher in gonads than in muscles. Both aliphatic and aromatic hydrocarbons were higher in somatic tissues than in gonads. Lipids appears to be not the only factor involved in the accumulation of hydrocarbons. All the liquid chromatographic profiles from the different scallop samples were similar. They mainly consisted of numerous two and three ring compounds. Temporal fluctuations were noted in PAH concentrations over several months of study. These were due in part to changes in biological and biochemical activities, and changes in the sea water temperature. In order to estimate the degree of coastal pollution in four commercial sites, the PAH burden of eight samples collected at nearly

the same period of the year were compared. The samples taken from Baie de St Brieuc were the least polluted. Baie de Brieuc is widely open on the Cyanne while Carantec, another sample site, is polluted by the neighboring towns and the remains of Amoco Cadiz and Tanio oil spills. The Brest area is located on a semienclosed bay polluted by chronic industrial ouputs and agricultural discharges. (Baker-IVI)
W85-04474

SIMULTANEOUS ACCUMULATIONS OF NAPHTHALENE, A PCB MIXTURE, AND BENZO(A)PYRENE, BY THE OYSTER, CRASSOSTREA VIRGINICA,
National Marine Fisheries Service, Charleston, SC. Southeast Fisheries Center.
A. R. Fortner, and L. V. Sick.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 256-264, February, 1985. 3 Fig, 1 Tab, 17 Ref.

Descriptors: *Naphthalene, *Polychlorinated biphenyls, *Benzo(a)pyrene, *Oysters, *Bioaccumulation, Fate of pollutants, Organic compounds, Diet, Detritus.

Accumulations of C-14 labeled naphthalene by oysters fed detritus-like particulate matter, manufactured from ground Spartina alterniflora leaves, or from contaminants dissolved in ambient water, were antagonistically affected by the simultaneous exposure to multiple contaminants and were tissue specific. Unlike observed accumulations of naphthalene, accumulations of a C-14 labeled polychlorinated biphenyls (PCB) mixture by selected oyster tissues were not always antagonistically affected by simultaneous exposures to three organic contaminants. Tissue accumulations of radiolabeled benzo(a)pyrene were not significantly affected by the simultaneous presence of other organic contaminants. Among oysters fed detrital material, gill tissue accumulated significantly more benzo(a)pyrene than mantle, labial palps, or digestive diverticular tissues. When oysters ingested particulate matter sorbed with the mixed organic contaminants, benzo(a)pyrene concentrations in all tissues monitored were not significantly different than when oysters were exposed only to benzo(a)pyrene. Similarly, when oysters were exposed to dissolved organics, simultaneous exposure to naphthalene and PCB's did not result in significant changes in tissue concentrations of benzo(a)pyrene. (Baker-IVI)
W85-04477

BIRD USE AND HEAVY METAL ACCUMULATION IN WATERBIRDS AT DREDGE DISPOSAL IMPOUNDMENTS, CORPUS CHRISTI, TEXAS,
Patuxent Wildlife Research Center, Laurel, MD.
D. H. White, and E. Cromartie.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 295-300, February, 1985. 2 Tab. 10 Ref.

Descriptors: *Water birds, *Heavy metals, *Spoil banks, *Corpus Christi, *Texas, Lead, Zinc, Cadmium, Mercury, Selenium, Birds, Fate of pollutants.

Biweekly mid-morning waterbird censuses were taken at three dredge-pits on the industrialized south shore of Nueces Bay, Corpus Christi, Texas during May 1981 - July 1982. Fifty-six species of birds were observed feeding in one or more of the dredge-pits. Nine species were present more than 20% of the total census periods. The censuses were begun about a year after the impoundments were filled with dredge material. In three sediment samples analyzed, element concentrations were quite variable. Geometric means were lead, 49.2 ppm; zinc, 847.6 ppm; cadmium, 7.5 ppm; mercury, 0.5 ppm; and selenium, 2.3 ppm. Lead, zinc, cadmium, and mercury did not accumulate to elevated levels in aquatic birds using the dredge-pits when compared to birds from undeveloped areas. Selenium in some birds from dredge-pits was within the range known to cause reproductive impairment in chickens. It is unknown whether these elevated selenium levels adversely affect wild aquatic birds. (Baker-IVI)
W85-04480

REGIONAL RIVER SULFUR RUNOFF,
Washington Univ., St. Louis, MO. Center for Air Pollution Impact and Trend Analysis.
R. B. Husar, and J. D. Husar.
Journal of Geophysical Research, Vol. 90, No. C1, p 1115-1125, January, 1985. 5 Fig, 3 Tab, 39 Ref.

Descriptors: *Sulfur, *Runoff, *Water pollution sources, Spatial distribution, Path of pollutants, Niger River, Volta River, Colorado River.

The water and sulfur runoff data for 54 large river basins were assembled, covering 65% of the nondesert land area of the world. The sulfur concentration ranges from 0.5 mg S/L for the West African rivers Niger and Volta to 100 mg S/L in the Colorado River; the world average is 3.2 mg S/L. The concentrations in central and eastern Europe as well as central and eastern North America exceed 8 mg S/L. The sulfur runoff density is also highest in the river basins over these industrialized regions, exceeding 2 g S/m2/yr. However, high sulfur runoff density in excess of 3 g S/m2/yr is also measured over the Pacific islands New Zealand and New Guinea and the archipelagos of Indonesia and the Philippines. The natural background sulfur runoff was estimated by assuming that South America, Africa, Australia, and the Pacific Islands are unperturbed by man and that the average river sulfur concentration is in the range 1-3 mg S/L. Taking these background concentration values, the man-induced sulfur runoff for Europe ranges between 2 and 8 times the natural flow, and over North America, man's contribution ranges between 1 and 5 times the natural runoff. The global sulfur flow from nondesert land to the oceans and the Caspian Sea is estimated as 131 Tg S/yr, of which 46-85 Tg S/yr is attributed to natural causes. The regional river sulfur runoff pattern discussed in this paper does not have enough spatial resolution to be directly applicable to studies of the environmental effects of man-induced sulfur flows. However, it points to the continental-size regions where those perturbations are most evident and to the magnitude of the perturbations as expressed in units of the natural flows. (Author's abstract)
W85-04481

GEOCHEMISTRY OF INORGANIC GERMANIUM IN NATURAL WATERS,
Florida State Univ., Tallahassee. Dept. of Oceanography.
For primary bibliographic entry see Field 2K.
W85-04482

MIGRATION AND SPECIATION OF LEAD IN A RIVER SYSTEM HEAVILY POLLUTED FROM A SMELTER,
Ceske Vysoke Uceni Technicke v Praze. Dept. of Nuclear Chemistry.
P. Benes, M. Cejchanova, and B. Havlik.
Water Research, Vol. 19, No. 1, p 1-6, 1985. 1 Fig, 1 Tab, 21 Ref.

Descriptors: *Lead, *Source of pollutants, *Fate of pollutants, *Smelters, Heavy metals, Anodic stripping voltammetry, Urban runoff, Particulates.

Anodic stripping voltammetry was used for the study of the migration and speciation of lead in surface water affected by atmospheric deposits around a smelter, by ore mining and urban runoff. Three physiococchemical forms of lead were distinguished: dissolved-labile ($Pb(2+)$, $PbOH(+)$ and $PbCO3$), dissolved-bound (colloids or strong complexes) and particulate (retained by 0.40 micro m membrane filter). Labile forms represented a very significant part of lead input from the washout of the atmospheric deposits, whereas most of lead from urban runoff and ore mining was in particulate or bound forms. Rather large stability of high concentrations of the labile forms of lead in the waters was found. It has been concluded that the precipitation of sparingly soluble lead compounds is not a primary factor controlling the concentration of dissolved lead in stream waters. The migration and speciation of lead was strongly affected by water flow rate. With increasing water flow rate, the concentration of particulate and labile lead increased whereas the concentration of bound forms decreased. Most of the lead was carried downstream in a small river during high water flow rate, but sedimented in a larger river. Rapid removal of lead by sedimentation occurred during low streamflow conditions. (Author's abstract)
W85-04484

MEASUREMENT OF PARTICULATE ASSOCIATION OF AMERICIUM IN FRESHWATER,
International Lab. of Marine Radioactivity, Monaco-Ville (Monaco).
For primary bibliographic entry see Field 5A.
W85-04491

DETERMINATION OF TRIALKYL AND TRIARYL PHOSPHATES IN ENVIRONMENTAL SAMPLES,
Kitakyushu Municipal Inst. of Environmental Health Sciences (Japan).
S. Ishikawa, M. Taketomi, and R. Shinohara.
Water Research, Vol. 19, No. 1, p 119-125, 1985. 4 Fig, 6 Tab, 9 Ref.

Descriptors: *Trialkyl phosphates, *Triaryl phosphates, *Plasticizers, *Chemical analysis, *Water pollution sources, *Kitakyushu City, *Japan, Gas chromatography, Mass spectrometry, Water analysis, Phosphate esters.

Trialkyl and triaryl phosphates are widely used as plasticizers, industrial hydraulic fluids and lubricant additives. Analytical methods for determination of trialkyl and triaryl phosphate esters in water and sediment were developed. A survey of their presence in sediments, seawater, and river water was performed in the area of Kitakyushu City, Japan. Products of extraction with dichloromethane (water sample) or acetone (sediment sample) were analyzed with a gas chromatograph equipped with a flame photometric detector and a gas chromatograph/mass spectrometer after cleanup through a Florisil column. The separation of gas chromatography was good with 2% OV-17 +2% PZ-179 on Uniport HPS. Recoveries fortified with 0.3-3 micro g were 71-98% for water sample and 78-95% for sediment sample. In the environmental survey, tributyl phosphate (5-36 ng/l), Tris (3-chloropropyl) phosphate (16-176 ng/l, Tris (2-chloroethyl) phosphate (TCEP) (14-347 ng/l), Tris (2,3-dichloropropyl) phosphate (CRP) (23-136 ng/l), triphenyl phosphate (13-31 ng/l), and tricresyl phosphate (67-259 ng/l) were detected in river water and seawater, and TCEP (13-28 ng/g) and CRP (9-17 ng/g) were detected in sediment. The pollution by phosphate esters is assumed to be affected by domestic wastewater because TBP, TCEP, CRP and TCP were observed in domestic wastewater and TBP, TCEP and CRP appeared in samples where little industrial wastewater was present and tidal action had no effect. (Collier-IVI)
W85-04497

ORGANIC ACIDITY IN PRECIPITATION OF NORTH AMERICA,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
W. C. Keene, and J. N. Galloway.
Atmospheric Environment, Vol. 18, No. 11, p 2491-2497, 1984. 3 Fig, 3 Tab, 20 Ref.

Descriptors: *Acid rain, *Organic compounds, *Precipitation chemistry, *Virginia, Formic acid, Acetic acid, Microorganisms, Fate of pollutants, Water pollution sources.

Organic anions were measured in 16 precipitation events sampled in central Virginia between 25 April and 1 October 1983. Formic and acetic acids contributed 16% of volume weighted free acidity. The decrease in free acidity in stored aliquots was directly proportional to the disappearance of dissociated $HCOO^-$ and $CH3COO^-$. The loss of free acidity between pH measured at field sites and at central laboratories was used to estimate dissociated organic acidity in samples collected by the

National Atmospheric Deposition Program (NADP) and the MAP3S Precipitation Chemistry Project. Based on the arithmetic means of the volume weighted averages for each site, we estimate that organic acids contributed 18-35% of free acidity in NADP samples and 16% of free acidity in MAP3S samples. The loss of free acidity in MAP3S samples was three times greater during the growing season than it was during the rest of the year. Because they are rapidly assimilated by microbes, organic acids are unimportant in the long-term acidification of the environment. (Author's abstract)
W85-04499

RAINBORNE SO2, PRECIPITATION PH AND AIRBORNE SO2 OVER SHORT SAMPLING TIMES THROUGHOUT INDIVIDUAL EVENTS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
T. D. Davies.
Atmospheric Environment, Vol. 18, No. 11, p 2499-2502, 1984. 2 Fig, 1 Tab, 9 Ref.

Descriptors: *Precipitation chemistry, *Hydrogen ion concentration, *Sulfur dioxide, *Norfolk, *England, Acid rain, Air pollution, Sample preservation, Water pollution sources.

Rainborn SO2 and precipitation pH were determined in samples collected sequentially in Norfolk, England (over periods varying from a few minutes to hours, depending on precipitation intensity) throughout a number of events. Rainfall was collected in amber-glass bottles containing tetrachloromercurate solution and in bottles without the TCM solution. During the sampled rain events airborn SO2 was measured on a 15-min basis by bubbling air through TCM at around 30 l/min; these data were utilized to compare observed rainborn SO2 levels with levels predicted from equilibrium theory. Much better agreement was found between observed SO2 washout ratios and those predicted from equilibrium theory than in previous studies when the sampling was over longer timebases. The pH of the precipitation samples lay in the range 3.3-6.0. The rainborne SO2 concentrations and pH values exhibit considerable variation, on a time-scale of a few minutes, throughout individual events. SO2 concentrations declined overall throughout the events although the decline was not uniform; this illustrates the concentration shifts in gas-phase SO2, aqueous-phase SO2 and H(+) concentrations. (Collier-IVI)
W85-04500

ATMOSPHERIC HEAVY METALS IN HIGH ALTITUDE SURFACE SNOWS FROM MONT BLANC, FRENCH ALPS,
Laboratoire de Glaciologie et Geophysique de l'Environnement, Grenoble (France).
F. M. Batifol, and C. F. Boutron.
Atmospheric Environment, Vol. 18, No. 11, p 2507-2515, 1984. 2 Fig, 5 Tab, 50 Ref.

Descriptors: *Snow, *Mont Blanc, *French Alps, *France, *Heavy metals, *Precipitation chemistry, Atomic absorption, Lead, Cadmium, Copper, Zinc, Silver, Sodium, Manganese, Potassium, Calcium, Iron, Aluminum, Metals, Metalloids, Water pollution sources.

Heavy metals and metalloids in snow and ice layers in high altitude cold alpine glaciers in Europe and other mid-latitude areas have not been extensively investigated. Surface snow samples were collected in June 1973 in the massif of Mont Blanc, French Alps, at three separate sites whose altitude ranges from 3560 to 4785 m a.s.l. These samples were collected using ultra-clean techniques and analyzed for Pb, Cd, Cu, Zn, Ag, Na, Mg, K, Ca, Fe, Al and Mn by Graphite Furnace Atomic Absorption in clean room conditions. Measured concentrations are very low, indicating the extreme purity of high altitude snow in the Alps. Principal components factor analysis of the data suggest a crustal source for Na, Mg, K, Ca, Fe, Mn and Al. Heavy metals Pb, Cd, Cu, Zn and Ag are found on the other hand to be derived from one or several sources independent of the crustal source. Concentrations of the investigated heavy metals ranged from 1 to 15 times 10 to the -9 power g/g for Pb and Zn, from 0.1 to 1 times 10 to the -9 power g/g for Cu, from 20 to 500 times 10 to the -12 power g/g for Cd, and from 10 to 40 times 10 to the -12 power g/g for Ag. Concentrations of the other elements ranged from 10 to the -8 power to 10 to the -7 power for for Na, Mg, K, Ca, Fe, and Al, and from 1 to 10 times 10 to the -9 g/g for Mn. Measured concentrations in snow appear to be closely related to those previously published by other authors for local aerosols. (Collier-IVI)
W85-04501

LONG-TERM TRENDS IN PRECIPITATION CHEMISTRY AT HUBBARD BROOK, NEW HAMPSHIRE,
New York Botanical Garden, Bronx, NY.
G. E. Likens, F. H. Bormann, R. S. Pierce, J. S. Eaton, and R. E. Munn.
Atmospheric Environment, Vol. 18, No. 12, p 2641-2647, 1984. 9 Fig, 2 Tab, 15 Ref.

Descriptors: *Precipitation chemistry, *Hubbard Brook, *West Thornton, *New Hampshire, *Acid rain, Sulfates, Nitrates, Ammonium, Chlorides, Magnesium, Calcium, Hydrogen ion concentration, Temporal distribution, Trends.

A continuous, 19-year record (1963-1982) of weekly, bulk precipitation chemistry at the Hubbard Brook Experimental Forest in West Thornton, New Hampshire shows no statistically significant trend in annual volume-weighted concentrations of hydrogen ion and nitrate, but a 34% decrease in sulfate, a 34% decrease in ammonium, a 63% decrease in chloride, a 79% decrease in magnesium and an 86% decrease in calcium during the period. Nitrate concentrations increased from 1964 to 1971 and H-ion concentrations decreased after 1970. Frequency distributions of the concentrations of the chemical components of precipitation are skewed. The range of H-ion concentrations in weekly samples has narrowed, and the frequency distribution has shifted toward higher concentrations (lower pH) during the last 19 years. Highest concentrations generally occur with lowest amounts of precipitation for most ions, but low concentrations can occur with either low or high amounts of precipitation. Time trends in deposition generally parallel trends in concentration over the 19-year period. Chemical deposition generally increases with increasing amount of precipitation in weekly samples. (Author's abstract)
W85-04502

COMPOSITION OF PRECIPITATION ON AMSTERDAM ISLAND, INDIAN OCEAN,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
J. N. Galloway, and A. Gaudry.
Atmospheric Environment, Vol. 18, No. 12, p 2649-2656, 1984. 6 Fig, 4 Tab, 13 Ref.

Descriptors: *Amsterdam Island, *Indian Ocean, *Precipitation chemistry, *Acid rain, Hydrogen ion concentration, Sulfate, Nitrate, Chlorides, Sodium, Magnesium, Potassium, Calcium, Organic acids, Isotopic tracers.

The composition of precipitation on Amsterdam Island, in the central Indian Ocean was investigated, as were the processes controlling the precipitation composition and the acids responsible for the observed acidity. The data set comprises 66 rain events collected over a 30 month period and analyzed for SO4(-2), NO3(-), Cl(-), CH3COO(-), HCOO(-), Na(+), Mg(2+), K(+), Ca(2+), H(+), strong acidity and total acidity. Supporting data used in data analysis include Rn-222 and meteorological parameters. Precipitation on Amsterdam Island has two components, seawater and acid. Using Mg(2+) as the seawater tracer, there is no significant difference between the K(+)/Mg(2+), Cl(-)/Mg(2+), Na(+)/Mg(2+) and Ca(2+)/Mg(2+) ratios of the rain and those of seawater. The SO4(-2)/Mg(2+) ratio is significantly larger than the seawater ratio. The acid component is substantially smaller than the seasalt component. The volume weighted pH of the precipitation samples is 5.06 with primary proton donors being H2SO4, organic acids (HCOOH and CH3COOH) and HNO3. The maximum contributions of these acids to precipitation acidity are 30, 25 and 15%, respectively. There is an interaction between the alkaline seawater component and the acidic component. Specifically, using Mg(2+) as a tracer of seawater alkalinity, there is, on the average, a loss of 10% of the original free acidity due to neutralization. Specific samples ranged from < 10 to 50% neutralization, depending on the relative magnitude of the acid and seawater components. Rn-222 was used as a tracer to estimate the influence of the long range transport of marine and continental material on the composition of Amsterdam Island precipitation. A comparison of the SO4(-2*), NO3(-), H(+) and CH3COO(-) and HCOO(-) concentrations between events with a continental source area and those with a marine source area revealed a possible continental influence on NO3(-) only. (Author's abstract)
W85-04503

WET DEPOSITION OF TRACE METALS TO THE WESTERN ATLANTIC OCEAN AT THE MID-ATLANTIC COAST AND ON BERMUDA,
Delaware Univ., Newark. Coll. of Marine Studies.
T. M. Church, J. M. Tramontano, J. R. Scudlark, T. D. Jickells, and J. J. Tokos, Jr.
Atmospheric Environment, Vol. 18, No. 12, p 2657-2664, 1984. 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Trace metals, *Lewes, *Delaware, *Bermuda, *Precipitation chemistry, Cadmium, Copper, Iron, Manganese, Nickel, Lead, Vanadium, Zinc, Metals.

The concentration of the trace metals Cd, Cu, Fe, Mn, Ni, Pb, V and Zn has been measured in atmospheric precipitation events at the middle Atlantic coast (Lewes, DE) and on the western Atlantic island of Bermuda. The purpose is to assess the sources, transport, and wet deposition of trace metals to the western Atlantic during non-summer months when trace metals are likely to be transported by westerly air mass flow from N America to the open Atlantic. The concentrations, and wet deposition of trace metals are greater at the coast than on Bermuda, and the other at both sites (Fe > Zn > Pb > Cu, Mn, Ni > V > Cd) is similar. The trace metal enrichment factors for all metals but Mn, based on crustal Fe, are significantly greater than unity, and the order (Cd > Pb > Zn > Cu > Ni > V) is also the same at the coast as on Bermuda. This evidence suggests common sources from North America for trace metals in western Atlantic precipitation and important atmospheric transport of trace metals to the Atlantic Ocean. Calculations using enrichment factors from sea salt aerosol (Na based) indicate recycling of trace metals from the sea surface, while generally considered not to be important, could be a potentially significant process contributing to Mn and V enrichments in open western Atlantic precipitation. (Author's abstract)
W85-04504

ANALYSIS OF PRECIPITATION COLLECTED ON A SEQUENTIAL BASIS,
Pennsylvania State Univ., University Park. Dept. of Meteorology.
R. G. De Pena, T. N. Carlson, J. F. Takacs, and J. O. Holian.
Atmospheric Environment, Vol. 18, No. 12, p 2665-2670, 1984. 7 Fig, 5 Tab, 6 Ref. NOAA contract NA82RAC0157 and NOAA-DOE contract NA82RAC00032.

Descriptors: *Precipitation chemistry, *Acid rain, *Path of pollutants, Hydrogen ion concentration, Conductivity, Sulfates, Nitrates, Ammonium, Water pollution sources.

With the aim of establishing a source receptor relationship, precipitation was collected on a sequential basis at the Penn State MAP3S site from December 1979 to April 1980 and from September 1982 until the present; each sample was analyzed for pH, conductivity, sulfate, nitrate, ammonium and other ions. For each sample, air trajectories were determined according to the relative-wind

method on isentropic surfaces. A good correlation was obtained when the concentrations were related to the precipitation rate or intensity. The relationship can be expressed by a power law of the type C = a(I to the -b power) where C is the ion concentration, a and b are constants and I is the precipitation rate. The precipitation concentrations were also correlated with the source-strength, a number proportional to the emissions of SO2 or NOx along the path of the trajectories. The two values correlated in most of the events. If future work confirms these preliminary results, a method will be available on which pollution regulation can be based. (Collier-IVI)
W85-04505

COMPARATIVE STUDIES OF NO3- CONCENTRATIONS IN SOME TROPICAL RAINS,
Ibadan Univ. (Nigeria). Dept. of Physics.
A. I. I. Ette, and A. B. Udoimuk.
Atmospheric Environment, Vol. 18, No. 12, p 2781-2786, 1984. 5 Fig, 1 Tab, 37 Ref.

Descriptors: *Nitrates, *Precipitation chemistry, *Tropical regions, *Nigeria, Ibadan, Calabar, Atmospheric physics, Electric field intensity, Electrical studies.

Apart from electrical discharges in the atmosphere other sources of NOx production include photolytic action in the stratosphere, biological action in soils and anthropogenic activity. Values of nitrate ion concentration, electric field intensity Eo, field reversal frequency and rainfall intensity R were measured on an event basis for rain events monitored at Ibadan and Calabar located in the rain belt of Nigeria. Strong dependence of nitrate ion concentration on Eo demonstrates that NOx production by sources of a nonelectrical nature are unimportant, at least as far as the two stations investigated are concerned, and that electrical discharges are the major sources of NO3(-) in tropical rains. The nitrate-nitrogen deposition rate at Calabar correlates well with the total rainfall, each having a pronounced peak in August; while the nitrate concentration exhibits no significant or systematic monthly variation. The significantly high concentration in January is likely to be due to bush burning which normally precedes planting in most parts of the country. Mean nitrate concentrations compare well with those reported in the literature for other tropical locations. (Collier-IVI)
W85-04506

FRACTIONATION OF TRACE METALS IN ACIDIFIED FRESH WATERS BY IN SITU DIALYSIS,
National Swedish Environment Protection Board, Solna.
H. Borg, and P. Andersson.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 725-729, October, 1984. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Acidification, *Fractionation, *Dialysis, *Sulfur, *Nitrogen, *Sweden, Aluminum, Zinc, Manganese, Cadmium, Lead, Organic matter, Complexation, Fate of pollutants, Lakes.

The increased deposition of acid sulfur and nitrogen compounds over Sweden has caused an extensive acidification of lakes and streams during the last decades with severe damage to aquatic life as a consequence. Separation of metal fractions in lakewaters by in situ dialysis showed that the dialysable part was highest for Cd, followed by Cu, Al and Pb. The dialysable portion of Cd and Al increased with decreasing pH which was also the case for Pb in waters with low concentration of humic substances. In the more humic waters, the dialysable Pb-fraction was small, most likely because Pb is bound to colloidal organic matter, probably associated to hydrous ferric oxides. The influence of organic matter is further demonstrated by the negative correlation found between total organic carbon content and the dialysable fractions of Pb, Cu, and Al. (Baker-IVI)
W85-04535

IMPACT OF SEDIMENTATION ON THE PHOSPHORUS CONTENT OF THE EUPHOTIC ZONE OF LAKE CONSTANCE,
Konstanz Univ. (Germany, F.R.). Limnological Inst.
For primary bibliographic entry see Field 2H.
W85-04555

EXTERNAL AND INTERNAL LOADING AND RETENTION OF PHOSPHORUS IN THE R. JORKA LAKES (MASURIAN LAKELAND, POLAND) VS THEIR TROPHIC STATUS,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W85-04556

ROLE OF BIVALVES IN THE PHOSPHORUS AND NITROGEN BUDGET IN LAKES,
Polish Academy of Sciences, Lomianki. Inst. of Ecology.
For primary bibliographic entry see Field 2H.
W85-04558

STREAM PHOSPHORUS EXPORTS FROM PREALPINE WATERSHEDS WITH RESPECT TO GEOLOGY AND LAND USE,
Osterreichisches Eutrophieprogramm, Projekt Salzkammergutseen, A-4852 Weyregg, Austria.
O. Moog.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1071-1076, October, 1984. 3 Fig, 3 Tab, 15 Ref.

Descriptors: *Attersee watershed, *Salzkammergut, *Austria, *Phosphorus, *Land use, *Nutrients, Agricultural watersheds, Agricultural runoff, Erosion, Landslides, Water pollution sources.

Thirteen drainage basins, forming the major part of the direct catchment area of Attersee in the Salzkammergut lake district of Austria, were studied to test P export coefficients and to identify major diffuse sources of phosphorus as a basis for application of pollution control measures. Stream P exports from the 13 prealpine drainage basins varied between 7-245 kg TP per sq km and year. A range of 7-120 kg was usual. The lowest phosphorus exports were found in forested-rocky catchments of the calcite-dolomite region. The P losses from the flysh and morainic region were generally higher. The influence of agricultural land use on the P export could be studied due to a sewage collection system diverting the domestic and industrial wastewaters of the villages around Attersee to a central treatment plant which has been in operation since 1976. In a catchment area where the domestic and industrial sewage is served by purification systems, the percentage of agricultural land use can be used to estimate the range of the P export; a positive linear correlation between mean stream P concentration and percentage of land use was observed. No correlation was detected between discharge and TP concentrations. Active landslips within single drainage basins caused seriously high P exports (230 and 245 kg/sq km/yr); in these cases the high amount of suspended solids which contains P adsorbed at the soil particles is responsible for the high P load of these creeks. (Collier-IVI)
W85-04560

PCBS AND ORGANOCHLORINE PESTICIDES IN THE ST. LAWRENCE SYSTEM (BPC ET PESTICIDES ORGANOCHLORES DANS LE SYSTEME SAINT-LAURENT),
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard.
Canadian Water Resources Journal, Vol. 8, No. 2, p 32-63, 1983. 8 Fig, 8 Tab, 45 Ref.

Descriptors: *St. Lawrence River, *Polychlorinated biphenyls, *Chlorinated organic pesticides, Fish, Pesticides, Distribution, Estuaries.

Organochloro pesticides and polychlorobiphenyls (PCB) are among the most toxic anthropogenic compounds presently found in the environment. In the case of the St. Lawrence river in Eastern Canada, the concentrations of both these pollutants has been shown to be higher in water, sediments and fish from the stretch of the river upstream from the island of Orleans than those from samples taken downstream in the St. Lawrence estuary. In certain hot spots such as the run of the river at Montreal and the St. Louis and St. Francois lakes, the measured PCB concentrations in fish (11 species) were as high as 15 ppm; present Canadian legislation sets the maximum permissible level for fish destined for human consumption at 2 ppm. In both the estuary and the gulf of the St. Lawrence organochloro pesticide and PCB concentrations are lower and more uniformly distributed than those found upstream; one consequently finds relatively low levels of these compounds in the fish populations sampled downstream from the island of Orleans (9 species) although some cases are recorded where the concentrations of PCB are higher than 2 ppm. (Author's abstract)
W85-04581

FACTORS INFLUENCING THE BEHAVIOUR OF DE-ICING SALTS IN AN URBAN FLOOD CONTROL RESERVOIR,
Ontario Hydro, Toronto.
W. S. Scott.
Canadian Water Resources Journal, Vol. 8, No. 2, p 104-120, 1983. 3 Fig, 5 Tab, 9 Ref.

Descriptors: *Deicers, *Salts, *Flood control reservoirs, Reservoirs, Chlorides, Sodium, Thaw, Rainfall, Urban runoff, Path of pollutants, Saline water, Roads, Air temperature.

Water samples collected from a newly constructed reservoir and its watershed during a complete salting season indicated the presence of high concentrations of chloride and sodium in the bottom waters of the reservoir at the beginning of thaw periods. This effect occurred despite the fact that water flowing out of the reservoir is normally drawn from very near the bottom. The salt-laden bottom waters were eventually drained from the reservoir as the thaw periods continued, or after freezing temperatures returned. Elevated salt levels returned, however, at the beginning of each successive thaw period. The number and duration of thaw periods and associated rainfall were found to be major influences on the accumulation and behavior of the salt-laden waters. Factors influencing salt levels in the source streams were analyzed. Salt inputs were shown to be significantly correlated with: the amount of salt applied to streets prior to thaw periods, the degree of urbanization of the watershed, length and type of roads drained, the duration of thaw periods, precipitation, and the rate of rise in temperature at the start of thaw periods. (Author's abstract)
W85-04584

SMALL FORMAT, HAND HELD HELICOPTER BASED PHOTOGRAPHY FOR MONITORING INDUSTRIAL WATER EFFLUENT PLUMES,
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W85-04586

ATTENUATION OF CHEMICAL ELEMENTS IN ACIDIC LEACHATES FROM COAL MINERAL WASTES BY SOILS,
Los Alamos National Lab., NM.
L. E. Wangen, and M. M. Jones.
Environmental Geology and Water Sciences, Vol. 6, No. 3, p 161-170, 1984. 5 Fig, 6 Tab, 18 Ref.

Descriptors: *Mine wastes, *Leachates, *Coal mines, *Soil chemistry, Fate of pollutants, Percolation, Aluminum, Arsenic, Cadmium, Cobalt, Chromium, Copper, Fluorine, Iron, Manganese, Nickel, Zinc, Alkalinity.

The chemical attenuation of acidity and selected elements (aluminum, arsenic, cadmium, cobalt, chromium, copper, fluorine, iron, manganese, nickel, and zinc) in acidic leachates from coal mineral wastes by four natural subsurface soils has

been investigated using laboratory column methods. Leachate solutions were allowed to percolate through the soils under simulated natural flow conditions, and the elemental concentrations in the influents and effluents were measured periodically. Elemental retentions were substantial for all species except manganese, which was eluted in excess from all soils except the most calcareous. Two processes appeared to operate in decreasing influent concentrations: (1) precipitation of solid phases caused by increased pH of the leachate as it percolated through the soil, and (2) adsorption of elements onto exchange and sorption sites naturally present in the soil and on iron and aluminum oxide precipitates formed in situ from leachate components because of the increased pH. The soil property most important in retention was its alkalinty. Thus, carbonaceous soils provide the best control material for acidic leachates from coal mineral wastes. Results show that natural soils can substantially reduce pollutant fluxes to the environment from acidic coal waste dumps and should be considered when selecting waste disposal sites. (Author's abstract)
W85-04600

INVENTORIES AND SORPTION-DESORPTION TRENDS OF RADIOCESIUM AND RADIOCOBALT IN JAMES RIVER ESTUARY SEDIMENTS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
C. L. Zucker, C. R. Olsen, I. L. Larsen, and N. H. Cutshall.
Environmental Geology and Water Sciences, Vol. 6, No. 3, p 171-182, 1984. 1 Fig, 4 Tab, 26 Ref.

Descriptors: *Cesium radioisotopes, *Cobalt radioisotopes, *Sorption, *Desorption, *James River, *Virginia, Estuaries, Estuarine sediments, Fallout, Radioactive wastes, Fate of pollutants.

Anthropogenic radionuclides (Cs-137, Cs-134, Co-60) have been introduced to the James River estuary as a result of low-level releases from the Surry Reactor site since 1973 and worldwide atmospheric fallout from nuclear weapons tests since the early 1950s. The total radionuclide burden in the estuary sediments has been estimated by integrating radionuclide activities in 29 box cores and extrapolating these integrated values over surface areas subdivided on the basis of sediment type, rate of accumulation, and proximity to the reactor release site. The results indicate that 30% of the Co-60, but only 15% of the Cs-134 released from the reactor site, has been retained in the estuary sediments, and about 40% of the Cs-134 and Co-60 sediment inventory is in areas that represent less than 5% of the total estuarine surface area. Depletion of the Cs-134 in downstream sediments forms a noticeable trend in the James River estuary, and it is postulated that seawater cation competition and exchange is primarily responsible. (Author's abstract)
W85-04601

ASSESSMENT OF HISTORICAL CHANGE IN TWO NORTHERN MINNESOTA LAKES,
Minnesota Univ.-Duluth. Dept. of Biology.
J. R. Hargis, and L. J. Shannon.
Environmental Management, Vol. 8, No. 6, p 481-488, November, 1984. 7 Fig, 26 Ref.

Descriptors: *Ecosystems, *Water pollution effects, *Minnesota, *Hare Lake, *Echo Lake, Powerplants, Acid precipitation, Sulfates, Transparency, Zooplankton, Lakes, Variability.

Two northern Minnesota lakes (Hare and Echo Lakes) that had been studied in detail 22 years earlier (1958) were restudied to determine the extent of alteration in ecological conditions. Approximately one year after the original investigation, a coal-fired power plant, which incremented sulfate loading by about 6 kg/ha-yr, began operation nine miles away. These lakes lie within a region judged susceptible to acidic precipitation, though each lake, based on its buffering capacity, would be judged only moderately sensitive. In spite of the influence of this plant and other anthropogenic inputs, the change in lake ecology was apparently minimal. Water clarity decreased in both lakes and some alteration in zooplankton community structure was observed. The long-term utility of lake surveys depends upon how carefully and completely conditions can be reconstructed from records and reports. Past surveys generally omit measures of variability for the data, allowing only qualitative comparisons to be drawn. In order to judge the graded responses of aquatic ecosystems, necessary to sound management, quantitative measures are needed. (Author's abstract)
W85-04602

SNOW POLLUTION AND ITS EFFECT ON HEAVY METALS LOAD OF THE KOZLOWA GORA RESERVOIR AS COMPARED TO RAIN AND RIVER WATER,
Polish Academy of Sciences, Krakow. Zaklad Biologii Wod.
M. Reczynska-Dutka.
Polskie Archiwum Hydrobiologii, Vol. 31, No. 3, p 163-173, 1984. 1 Fig, 11 Tab, 32 Ref.

Descriptors: *Snow, *Rain, *Heavy metals, *Kozlowa Gora Reservoir, *Poland, Path of pollutants, Lead, Zinc, Cadmium, Cobalt, Nickel, Manganese, Iron, River water.

Studies were carried out during the winter of 1978-79 to determine the levels of Pb, Ni, Cd, Co, Zn, Mn and Fe in snow falling on the surface of the Kozlowa Gora drinking water reservoir, located along the northern limit of the Upper Silesia Industrial Region (Poland). The levels of the metals in snow are compared with those in rainfall and river water supplying the reservoir. Snow falling on the reservoir showed increased amounts of Zn, Pb, Cd, Mn and Fe. Snow transported at most one half of the load brought by rain, due to lower concentrations of heavy metals in snow and the lower amounts of precipitation in winter. In comparison to the river, rain carried three times more Zn, comparable amounts of Pb and Cd, and 40% or less of the other heavy metals. The load of Zn, Pb and Cd deposited by snow constituted about 30% of the influx with the river, and the other metals constituted less than 20%. Rain appears to be the most important source of Zn pollution of the ecosystem under study. (Moore-IVI)
W85-04611

GROUNDWATER SOURCE OF NITRATE IN NEARSHORE MARINE SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
D. G. Capone, and M. F. Bautista.
Nature, Vol. 313, No. 5999, p 214-216, 17 January 1985. 4 Fig, 34 Ref.

Descriptors: *Groundwater pollution, *Nitrates, *Marine sediments, Water pollution sources, Path of pollutants, Groundwater discharge, Hydraulic gradient, Salinity.

Subsurface discharge accounts for about 10-20% of the freshwater input to Great South Bay, New York. The upper aquifer is the presumed source of this discharge and, because it is heavily contaminated with nitrate, the groundwater may be an important source of nitrate to the bay. Determinations of the interstitial nutrient chemistry of freshly collected cores from nearshore sediments support this hypothesis. Pore-water nutrient profiles were determined in Great South Bay, New York, at a site near Patchogue. High rates of submarine groundwater discharge, typically 10-50 l/sq m/day were recorded. Core samples showed slight decreases in salinity and concomitant increases in nitrate below 20 cm. An anoxic zone with sulfate reduction between 5 and 10 cm was always noted in the core samples and active nitrification above it, possibly accounting for some of the anomalies in the profiles of nitrate and ammonium above 5 cm. The rate of submarine groundwater discharge is a function of the hydraulic gradient maintained by rainfall and heavy rain causes rapid rate increases. Although highly variable in time, cores taken after substantial rainfall showed increasing nitrate concentrations and decreasing salinities with depth. Submarine groundwater discharge is a source of nitrate which should be considered in estimates of nitrogen influx to coastal marine ecosystems. (Baker-IVI)
W85-04616

MIGRATION AND ATTENUATION OF SELECTED ORGANICS IN A SANDY AQUIFER - A NATURAL GRADIENT EXPERIMENT,
36635 Fairfield Road, Ingleside, IL 60041.
P. A. Sutton, and J. F. Barker.
Ground Water, Vol. 23, No. 1, p 10-16, January-February, 1985. 3 Fig, 18 Ref.

Descriptors: *Organic compounds, *Attenuation, *Solute transport, *Groundwater pollution, Tracers, Chlorides, Butyric acid, Phenol, Chlorophenol, Dimethyl phthalate, Path of pollutants, Fate of pollutants.

A natural gradient tracer test was conducted in an unconfined sandy aquifer at Borden, Ontario. N-butyric acid, phenol, p-chlorophenol, and dimethyl phthalate (DMP) were used as organic tracers at concentrations ranging from 70 to 100 ppm and chloride was used as a nonreactive tracer at a concentration of 243 ppm. Approximately 2,100 l were injected below the water table and were monitored with a three-dimensional network of bundle-type, multilevel piezometers over a period of 60 days and once again after 204 days. The plume gradually split into two zones due to local heterogeneity. The centers of mass for the organic compounds migrated at essentially the same rate as chloride, but attenuated at different rates. Butyric acid and phenol attenuated the most rapidly. Chlorophenol attenuated only slightly faster than chloride and DMP attenuated at roughly the same rate as chloride. Sorption does not appear to be important in the system studied. Dispersion and biodegradation probably produced the observed attenuation of organics. (Author's abstract)
W85-04635

GROUND-WATER CONTAMINATION AND WELL CONSTRUCTION IN SOUTHEAST NEBRASKA,
Nebraska Univ., Lincoln. Conservation and Survey Div.
M. E. Exner, and R. F. Spalding.
Ground Water, Vol. 23, No. 1, p 26-34, January-February, 1985. 7 Fig, 23 Ref.

Descriptors: *Wells, *Groundwater pollution, *Nebraska, Water pollution sources, Nitrates, Fecal coliforms, Animal wastes, Farm wastes, Atrizine, Alachlor, Well water.

The study area comprises 1100 sq mi of agricultural land in the lower Big Nemaha drainage basin in southeast Nebraska. Most of the farms are cash grain-livestock operations. Nitrogen fertilizer use is low. Nitrate-nitrogen (NO3-N) concentrations and total (TC) and fecal coliform (FC) densities were determined in ground water from 268 household and stock wells. Seventy-one percent of the samples had NO3-N concentrations above 10 mg/l and/or TC densities > or = 1/100 ml. Most of the NO3-N contamination is from the dissolution of manure in barnyards and corrals. The average delta N-15 value was + 11.9 0/00 for the 115 samples with NO3-N levels in excess of 8.5 mg/l. Only 10% of the wells met Nebraska's criteria for private well construction. NO3-N levels exceeded 10 mg/l in 4% of these wells while 30% contained one or more TC/100 ml. The highest incidence of NO3-N and coliform contamination occurred in dug (47%) or augered (80%) wells with open-jointed casing. Poorly constructed wells contained low levels of atrazine. One well contained alachlor. The limited availability of ground water supplies and still more limited supplies of good quality ground water have led to the formation of rural water districts, and the abandonment of many wells. These wells should be plugged to prevent direct contamination of the aquifer and the use of wells for waste disposal. (Moore-IVI)
W85-04637

NITROGEN-ISOTOPE RATIOS OF NITRATE IN GROUND WATER UNDER FERTILIZED FIELDS, LONG ISLAND, NEW YORK,
Geological Survey, Syosset, NY. Water Resources Div.
W. J. Flipse Jr., and F. T. Bonner.
Ground Water, Vol. 23, No. 1, p 59-67, January-February 1985. 3 Fig, 3 Tab, 32 Ref. NSF grant CHE 78-24176.

Descriptors: *Nitrates, *Nitrogen isotopes, *Groundwater pollution, *Long Island, *New York, Fertilizers, Water pollution sources, Pollutant identification.

Ground-water samples from two heavily fertilized sites in Suffolk County, New York, were collected through the 1978 growing season and analyzed for nitrate-N concentrations and nitrogen-isotope ratios. Six wells were at a potato farm; six were on a golf course. The purpose of this study was to determine whether the N-15/N-14 ratios (delta N values) of fertilizer are increased during transit from land surface to ground water to an extent which would preclude use of this ratio to distinguish agricultural from animal sources of nitrate in ground water. Ground water at both sites contained a greater proportion of N-15 than the fertilizers being applied. At the potato farm, the average delta N-15 value of the fertilizers was 0.2%; the average delta N-15 value of the ground-water nitrate was 6.2%. At the golf course, the average delta N-15 value of the fertilizers was - 5.9%, and that of ground-water nitrate was 6.5%. The higher delta N-15 values of ground-water nitrate are probably caused by isotopic fractionation during the volatile loss of ammonia from nitrogen applied in reduced forms (NH(+4) and organic-N). The delta N-15 values of most ground-water samples from both areas were less than 10%, the upper limit of the range characteristic of agricultural sources of nitrate; these sources include both fertilizer nitrate and nitrate derived from increased mineralization of soil nitrogen through cultivation. Previous studies have shown that the delta N-15 values of nitrate derived from human or animal waste generally exceed 10%. The nitrogen-isotope ratios of fertilizer-derived nitrate were not altered to an extent that would make them indistinguishable from animal-waste-derived nitrates in ground water. (Author's abstract)
W85-04641

EFFECT OF AGRICULTURAL LAND USE ON GROUND-WATER QUALITY IN A SMALL PENNSYLVANIA WATERSHED,
Science and Education Administration, University Park, PA. Northeast Watershed Research Center.
H. B. Pionke, and J. B. Urban.
Ground Water, Vol. 23, No. 1, p 98-80, January-February, 1985. 5 Fig, 3 Tab, 32 Ref.

Descriptors: *Groundwater, *Water quality, *Land use, *Pennsylvania, Geology, Forests, Cropland, Nitrates, Chlorides, Phosphates, Shales, Sandstone, Siltstone, Path of pollutants.

Groundwater analyses from 14 wells, taken over a 10-year period, were used to examine the impact of land use and geology on groundwater quality. The 7.4 sq km watershed, located in central Pennsylvania, contains two main land uses and three geologic zones. The uppermost zone is 95% forestland underlain by sandstone. The middle zone is siltstone and 72.5% cropland, while the lower zone is shale and 67% cropland. The groundwater quality of the forested sandstone was highly variable and often impacted by rainfall quality. Nitrates, chloride and phosphate concentrations were much higher in ground waters underlying cropland. The mean concentrations ranged from five to seven times those observed in ground water underlying forests. The contamination pattern is consistent with that computed from a nutrient balance, based on known fertilizer and manure use on local croplands. Potentially useful as chemical tracers, NO3-N and Cl appear most related to cropland impact, and Na appears to be related to the geological distribution. The greatest impact on groundwater quality was associated with the intensively cropped shales. This zone is located on the groundwater pathway from the agriculturally-impacted zone to the stream; the nitrate, chloride, and phosphate concentrations are greatly decreased due to mixing and dilution. The chemical nature of these ground waters reflects more the geochemistry of local geologic deposits than the impact of cropland use. (Moore-IVI)
W85-04642

DISPERSION MODELING OF MULTIPLE SOURCES USING THE HP-41CV,
New Hampshire Water Supply and Pollution Control Commission, Concord.
D. H. Allen.
Ground Water, Vol. 23, No. 1, p 85-89, January-February, 1985. 3 Ref.

Descriptors: *Dispersion, *Model studies, Plumes, Injection wells, Wells, Computer models.

WMPLUME is an analytic dispersion model based on the Wilson and Miller equation presented in a program for the HP-41CV handheld, programmable calculator, the HP-41CX, or the HP-41C with four memory modules. The user specifies the spacing and extent of the field of observation points. The calculator can handle up to 36 fully penetrating, continuous injection well sources or a lesser number of discontinuous wells. The time of observation can be changed easily and sources can be added or deleted readily. The code is prepared for use with or without a printer attached to the calculator. (Author's abstract)
W85-04644

SPATIAL DISTRIBUTIONS OF PRECIPITATION ACIDITY AND MAJOR ION WET DEPOSITION IN NORTH AMERICA DURING 1980,
Atmospheric Environment Service, Downsview (Ontario).
L. A. Barrie, and J. H. Hales.
Tellus, Vol. 36B, p 333-355, 1984. 15 Fig, 2 Tab, 35 Ref.

Descriptors: *Spatial distribution, *Acid precipitation, *Ions, *North American, Ammonium, Nitrates, Sulfates, Hydrogen ions, Sulfuric acid, Air pollution, Precipitation chemistry, *Acid rain, Water pollution sources.

Observations are presented of the mean annual concentration and deposition of H(+), SO4(-2), NO3(-), and NH4(+) ions in precipitation in North America during 1980. The concentration and deposition of hydrogen, sulfate and nitrate ions in precipitation was highest in eastern North American, where the majority of anthropogenic sulfur and nitrogen oxide emissions occur. A definite southward shift in sulfate and nitrate maxima occurrs in 1980, compared to merged-network data from previous years. This apparent shift is caused primarily by sampling artifacts in the older CANSAP data. Precipitation is most acidic in the region covering New York, Pennsylvania, Ohio, Indiana, Illinois, Kentucky, West Virginia, and the southern half of the province of Ontario. This same region receives the highest wet deposition of hydrogen, sulfate and nitrate ions and is the source of sulfur and nitrogen. Of the anthropogenic sulfur and nitrogen oxides released in the eastern North American budget area, 24 and 25% are removed by precipitation in the same area, respectively. The rest are dry deposited or discharged from the area. There is evidence that nitrogen oxides are wet removed somewhat more effectively than sulfur oxides within selected subregions of the eastern North American budget area. The concentration and deposition patterns of sulfate, nitrate and hydrogen ions are similar to each other but differ from those of NH4(+). The former are influenced by emissions of anthropogenic oxides of sulfur and nitrogen while the latter originates mainly from natural sources with a maximum source strength in the center of the continent. Precipitation acidity has increased in the southeastern US since the 1950s. In the region of maximum deposition, 1980 observations of annual wet deposition of hydrogen sulfate and nitrate ions are within 25% of the 5-year mean. (Baker-IVI)
W85-04647

TRENDS IN LAKE ROTORUA WATER QUALITY,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
For primary bibliographic entry see Field 2H.
W85-04669

GROUNDWATER QUALITY PROTECTION: THE ISSUE IN PERSPECTIVE,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5G.
W85-04683

EFFECT OF POLLUTION ON THE COASTAL WATERS OF THE RED SEA IN FRONT OF JEDDAH, SAUDI ARABIA; 2. NUTRIENT SALTS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
For primary bibliographic entry see Field 5C.
W85-04711

RADIUM VARIABILITY PRODUCED BY SHELF-WATER TRANSPORT AND MIXING IN THE WESTERN GULF OF MEXICO,
Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 2K.
W85-04712

TRACKING RIVER PLUMES WITH VOLATILE HALOCARBON CONTAMINANTS: THE NIAGARA RIVER-LAKE ONTARIO EXAMPLE,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
M. E. Comba, and K. L. E. Kaiser.
Journal of Great Lakes Research, Vol. 10, No. 4, p 375-382, 1984. 15 Fig, 9 Ref.

Descriptors: *Plumes, *Halocarbons, *Niagara River, *Lake Ontario, *Halogenated hydrocarbons, *Fate of pollutants, Chlorinated hydrocarbons, Brominated hydrocarbons, Hypolimnion, Lakes.

The concentrations of six predominant volatile halocarbon contaminants CCl4, total and industrial CHCl3, CHBrCl2, CH2Cl2, CFCl3, and C2Cl4 in epi- and hypolimnetic lake waters are used to demonstrate tributary plumes and nearshore currents on the Lake Ontario/Niagara River example. The relative speed and sensitivity of the analysis for volatile halocarbons provides for a synoptic view of the major currents at the time of sampling. For example, the individual distributions of several contaminants indicate the existence of a Niagara River surface water plume in northerly direction for approximately 8 km into the lake. In contrast, the predominantly east-west isostats of the contaminant concentrations in the hypolimnetic water indicate little direct influences by the Niagara River and show the existence of other contaminant sources in these areas. (Author's abstract)
W85-04715

ENVIRONMENTAL IMPACT OF TWO, ADJACENT, HAZARDOUS WASTE DISPOSAL SITES IN THE NIAGARA RIVER WATERSHED,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 5C.
W85-04718

SHORT-TERM UPTAKE OF HEAVY METALS BY PERIPHYTON ALGAE,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Vymazal.
Hydrobiologia, Vol. 119, No. 3, p 171-179, December, 1984. 5 Fig, 8 Tab, 40 Ref.

Descriptors: *Heavy metals, *Periphyton, *Algae, *Bioaccumulation, Metals, Water pollution effects, Lead, Cadmium, Copper, Cobalt, Chromium, Nickel, Zinc, Iron, Manganese, Humic acids, Cladophora, Oedogonium, Chlorophyta.

The utilization of periphyton activity for the removal of heavy metals from enriched small streams has been examined. By means of short-term batch laboratory experiments the courses of metal uptake have been studied. Naturally growing periphyton community filamentous algae Cladophora glomerata and Oedogonium rivulare were used for uptake study; uptake of nine heavy metals - Pb, Cd, Cu, Co, Cr, Ni, Zn, Fe and Mn - was determined during four hours of exposure. In addition the influence of humic substances on heavy metal uptake has been determined. Uptake of all metals increased during four hours of exposure but not in the same way. Some metals were removed continuously (Ni, Cr, Fe and Mn), other metals were removed more rapidly during the first hour or first two hours of exposure and then only slight removal continued (Cu, Pb, Cd, Co). Uptake of Zn was rather unambiguous. Results of these experiments suggest that the course of uptake for individual metals could be similar for most periphyton algae. It was established that humic substances significantly reduce heavy metal uptake. The highest decrease of uptake was observed in Cu, Cr, Co and Cd. The results of model experiments are being tested in a pilot scale with respect to the demands of engineering practice. (Author's abstract)
W85-04721

INTERNAL P LOADING IN LAKES: A DIFFERENT APPROACH TO ITS EVALUATION,
Commission of the European Communities, Ispra (Italy). Joint Research Centre.
For primary bibliographic entry see Field 2H.
W85-04723

TRACE METALS IN OXIC LAKE SEDIMENTS: POSSIBLE ADSORPTION ONTO IRON OXYHYDROXIDES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
A. Tessier, F. Rapin, and R. Carignan.
Geochimica et Cosmochimica Acta, Vol. 49, No. 1, p 183-194, January, 1985. 5 Fig, 5 Tab, 54 Ref.

Descriptors: *Lake sediments, *Trace metals, *Adsorption, *Iron oxyhydroxides, *Ontario, Fate of pollutants, Cadmium, Copper, Nickel, Lead, Zinc, Hydrogen ion concentration.

Apparent overall equilibrium constants for the adsorption of Cd, Cu, Ni, Pb and Zn onto natural iron oxyhydroxides have been calculated from the partitioning of these trace metals in oxic lake sediments and the in situ measurement of trace metal concentrations in the associated pore waters. Such values obtained from three lakes of various pH located on the Precambrian Shield, in the area of Sudbury, Ontario, are compared with equilibrium constants obtained for the adsorption of the trace metals onto iron oxyhydroxides in well-defined media. Despite the complexity of natural waters and the great number of parameters that can influence adsorption, the agreement of the field data with the laboratory experiments and with theory is relatively good. In two of the lakes, the partitioning of Cd, Ni and Zn between the pore waters and the iron oxyhydroxides would be adequately predicted by a model describing the adsorption of these trace metals at low surface coverage onto amorphous iron oxyhydroxides in a NaNO3 solution. The results suggest that adsorption of Cd, Cu, Ni, Pb and Zn onto iron oxyhydroxides is involved in the lowering of trace metal concentrations in the oxic pore waters of the studied lakes below the concentrations prescribed by equilibrium solubility models. (Baker-IVI)
W85-04757

FLUID TRANSPORT PROCESSES IN UPPER SPENCER GULF,
Adelaide Univ. (Australia). Dept. of Mathematical Physics.
For primary bibliographic entry see Field 2L.
W85-04762

PHYSICAL PROCESSES AND POLLUTION IN THE WATERS OF SPENCER GULF,
Adelaide Univ. (Australia). Dept. of Applied Mathematics.
For primary bibliographic entry see Field 2L.
W85-04763

REGIONAL VARIATION IN THE DISTRIBUTION OF TRACE METALS IN MODERN INTERTIDAL SEDIMENTS OF NORTHERN SPENCER GULF, SOUTH AUSTRALIA,
Adelaide Univ. (Australia). Dept. of Geology and Mineralogy.
P. Harbison.
Marine Geology, Vol. 61, No. 2/4, p 221-247, November, 1984. 5 Fig, 10 Tab, 56 Ref.

Descriptors: *Spencer Gulf, *South Australia, *Trace metals, *Path of pollutants, Sediment transport, Spatial distribution, Estuaries, Heavy metals, Industrial wastewater, Intertidal sediments, Industrial wastes, Nitric acid, Littoral environment.

Northern Spencer Gulf, a marine inlet extending 170 km inland from the open sea, is a narrow, almost landlocked, water body seltered by the Cultana Hills to the west and the Flinders ranges to the east. Intertidal sediments near metal industries in northern Spencer Gulf have surface enrichments of nitric acid soluble Cd, Cr, Fe, Mn, Pb and Zn up to two orders of magnitude greater than sediments from non-industrial areas. Controlling influences on the distribution of these metals appear to be proximity to the source, the direction of littoral transport, and the environment of deposition. Changes in sedimentation resulting directly from a shoreline construction at Whyalla are predictable, and suggest the use of such structures to direct the transport of contaminated particulates to desired locations. (Baker-IVI)
W85-04764

WATER UTILITY IN THE NUCLEAR AGE,
A. F. Wigglesworth.
Water and Pollution Control, Vol. 122, No. 6, p 20, 22, 24, 27 and 75-78, December, 1984.

Descriptors: *Nuclear explosions, *Fallout, *Utilities, *Water supply, *Canada, Water pollution sources, Drinking water, Water conveyance, Planning, Decision making, Radioactive wastes, Water treatment facilities.

Water facilities in Canada are highly vulnerable to nuclear attack. Fallout settling on the surface of the earth will contaminate any water with which it comes in contact in one of three ways: immediate fallout, delayed fallout (deposited on watersheds and washed into supply tributaries or reaching other surface water supplies), or deferred fallout (deposited on snow or ice on watersheds and frozen rivers, lakes or reservoirs). A large proportion of the post attack population will have ground source water available which is free of radioactivity. Communities that must rely on surface sources would be subject to far greater dangers than drinking contaminated water. Water softening and purification plants would provide sufficient decontamination of water to significantly reduce the absorbed doses to body organs. Water source contamination by fallout would be a secondary problem in any post attack environment. Water distribution would be the major problem. Various design considerations to make the problem less acute are considered. Steps to be taken in resuming operations after an attack include: assessment of physical damage, the use of mobile treatment facilities, quality control, and supplying public information. (Baker-IVI)
W85-04773

TOXICOLOGIC STUDIES ASSOCIATED WITH THE AGRICULTURAL USE OF MUNICIPAL SEWAGE SLUDGE AND HEALTH EFFECTS AMONG SEWAGE TREATMENT PLANT WORKERS,
New York State Coll. of Veterinary Medicine, Ithaca.
For primary bibliographic entry see Field 5E.
W85-04776

MULTIPHASE APPROACH TO THE MODELING OF POROUS MEDIA CONTAMINATION BY ORGANIC COMPOUNDS; I. EQUATION DEVELOPMENT,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
L. M. Abriola, and G. F. Pinder.
Water Resources Research, Vol. 21, No. 1, p 11-18, January, 1985. 2 Fig, 34 Ref. DOE contract DE-AC02-79EV10257.

Descriptors: *Mathematical equations, *Organic compounds, *Porous media, Capillary water, Path of pollutants, Model studies, Solute transport, Gas phase.

The infiltration and migration of a chemical contaminant in the subsurface is a complex process. A multiphase approach to the modeling of organic compound migration in the subsurface is presented. This comprehensive approach makes it possible to describe the simultaneous transport of a chemical contaminant in three physical forms: as a nonaqueous phase, as a soluble component of a water phase, and as a mobile fraction of a gas phase. Using volume-averaging theory, equations governing such migration were developed from basic conservation of mass principles for a two-component contaminating phase. Incorporated within these equations are the effects of matix and fluid compressibility, gravity phase composition, interphase mass exchange, capillarity, diffusion, and dispersion. The resulting equations form a system of three nonlinear partial differential equations in five unknowns, two capillary pressures and three mass fractions. On the basis of the concept of local equilibrium between the phases, two constraints relating mass fractions were formulated to close this mathematical system. (Baker-IVI)
W85-04787

MULTIPHASE APPROACH TO THE MODELING OF POROUS MEDIA CONTAMINATION BY ORGANIC COMPOUNDS; 2. NUMERICAL SIMULATION,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
L. M. Abriola, and G. F. Pinder.
Water Resources Research, Vol. 21, No. 1, p 19-26, January, 1985. 11 Fig, 1 Tab, 13 Ref. DOE contract DE-AC02-79EV10257.

Descriptors: *Organic compounds, *Model studies, *Simulation, *Porous media, Gravity, Finite different methods, Plumes, Infiltration, Path of pollutants, Hydrocarbons.

A multiphase approach to the modeling of organic compound migration in the subsurface has been presented. The equations developed to govern such migration arose from the basic principles incorporating the effects of matrix and fluid compressibility, gravity, phase composition, interphase mass exchange, capillarity, and diffusion/dispersion. To demonstrate the applicability of the approach, a one dimensional implicit, finite difference model was developed and used to simulate the infiltration of a hydrocarbon mixture in a soil column. Migration of the organic phase along with the migration of the contaminant plume in the gas and water phases was simulated. Convergence of the model's iteration scheme was demonstrated heuristically for this problem, along with the convergence of the difference scheme in space and time. A mass balance performed on the heavy organic fraction component indicated that mass was being conserved in the system. Thus a workable model has been developed which can describe much of the complexity of subsurface contaminant migration heretofore unexamined. (Baker-IVI)
W85-04788

BIODEGRADATION OF ORGANIC CHEMICALS,
New York State Coll. of Agriculture and Life

Sciences, Ithaca.
M. Alexander.
Environmental Science and Technology, Vol. 19, No. 2, p 106-111, 1985. 3 Fig, 38 Ref.

Descriptors: *Fate of pollutants, *Organic compounds, *Biodegradation, Kinetics, Microorganisms, Mineralization, Cometabolism.

The rates of mineralization of some organic compounds are directly proportional to their concentration, so predictions of biodegradation rates can be made using laboratory tests of high levels of chemicals. With these compounds, however, the kinetics of the process and therefore the shapes of the curves of chemical disappearance will be a function of concentration. Other chemicals are mineralized at trace levels but may be cometabolized only at higher concentrations. There is a threshold below which certain, usually mineralizable molecules are not converted to carbon dioxide. Microorganisms may not assimilate carbon from chemicals present in trace amounts in natural environments; they will not grow or produce the large, acclimated populations needed for enhanced biodegradation. It is possible to predict the minimum concentration of a chemical necessary to support microbial growth. Based on these findings, tests of biodegradation, mineralization, or cometabolism that are performed using chemical concentrations greater than those that prevail in nature may lead to erroneous conclusions about the occurrence, rates, and products of microbial transformation in nature. (Baker-IVI)
W85-04797

EFFECTS OF DISSOLVED ORGANIC CARBON ON THE ADSORPTION PROPERTIES OF PLUTONIUM IN NATURAL WATERS,
Argonne National Lab., IL. Energy and Environmental Systems Div.
D. M. Nelson, W. R. Penrose, J. O. Karttunen, and P. Mehlhaff.
Environmental Science and Technology, Vol. 19, No. 2, p 127-131, 1985. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Dissolved solids, *Organic carbon, *Adsorption, *Plutonium, Natural waters, Fate of pollutants, Colloids, Particulate matter, Organic matter, Sediments.

The hazard associated with the entry of plutonium into aquatic systems is largely determined by the extent to which it remains in solution. Its movement from areas of confinement or known contamination into uncontaminated areas is controlled by the proportion existing in the dissolved phase. The colloidal organic carbon (COC) found in natural aquatic systems is a major factor controlling the distribution of reduced plutonium between solid and dissolved phases. COC inhibits the adsorption of reduced plutonium (oxidation states III or IV) to suspended sediment particles. This effect can be described by a system of equilibria in which COC competes with the solid particles for Pu (III, IV). Pu (III, IV) forms both 1:1 and 1:2 complexes with COC. Low pH conditions suppress the formation of 1:2 complexes but not 1:1 complexes. When corrected for the influence of COC, the intrinsic adsorption coefficient for plutonium (III, IV) falls in the range (500,000 to 3,000,000) for all the surface waters examined. On a weight basis, the COC and natural sediments have approximately equal affinities for plutonium, except in Lake Michigan waters where the COC had substantially less affinity for plutonium. This may be related to the very long residence time of water in Lake Michigan, which may result in more highly degraded organic matter with fewer functional groups juxtposed to chelate metals. (Moore-IVI)
W85-04799

INFLUENCE OF PH AND IONIC STRENGTH ON THE AQUEOUS-NONAQUEOUS DISTRIBUTION OF CHLORINATED PHENOLS,
Oregon State Univ., Corvallis. Dept. of Chemistry.
J. C. Westall, C. Leuenberger, and R. P. Schwarzenbach.
Environmental Science and Technology, Vol. 19, No. 2, p 193-198, 1985. 4 Fig, 4 Tab, 18 Ref.

Descriptors: *Chlorinated phenols, *Hydrogen ion concentration, *Ionic strength, Phenols, Chlorinated hydrocarbons, Aqueous phase, Nonaqueous phase, Counterions, Tetrachlorophenol, Pentachlorophenol, Octanol.

The distribution ratio of hydrophobic ionizable organic compounds (HIOC's) between aqueous and nonaqueous phases is shown to depend on the pH and ionic strength of the aqueous phase. Four models are presented to describe the association of the HIOC with the nonaqueous phase: (i) transfer of the neutral organic species from the bulk of the aqueous phase to the bulk of the nonaqueous phase: (ii) transfer of the ionic organic species with inorganic counterions to the bulk of the nonaqueous phase; (iii) transfer of the ionic organic species to the aqueous-non-aqueous interface with inorganic counterions in the aqueous phase; (iv) association of the organic species with specific functional groups of the nonaqueous phase. The distribution of 2,3,4,5-tetrachlorophenol and pentachlorophenol in the two-phase system composed of KOH, KCl, H2O, octanol, and the chlorophenol was determined as a function of ionic strength and interpreted quantitatively in terms of models i and ii. For aqueous phases with high pH values and ionic strengths, the dominant species of the chlorophenols in the octanol phase were the chlorophenolate ions in association with K(+) counterions. (Author's abstract)
W85-04803

BEHAVIOUR OF ORGANIC MICROPOLLUTANTS (PAH, PCB, AND BHC) AND OF A FECAL STEROL IN THE HUSUM ESTUARY AND IN THE ADJACENT NORTH FRISIAN WADDEN SEA (VERHALTEN ORGANISCHER UMWELTCHEMIKALIEN (PCA, PCB UND HCH) UND EINES FAKALEN STEROLS IN DER HUSUMER AUE UND AUF DEN ANGRENZENDEN WATTERN - NORDFRIESLAND),
Bayreuth Univ. (Germany, F.R.).
R. Herrmann, W. Thomas, and D. Hubner.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 4, p 101-107, October, 1984. 10 Fig, 3 Tab, 26 Ref.

Descriptors: *Coprostanol, *Polychlorinated biphenyls, *Polynuclear aromatic hydrocarbons, *BHC, *Husum Estuary, *Germany (Federal Republic), North Sea, Spatial distribution, Hydrocarbons, Pesticides, Algae, Sediments, Fate of pollutants, Tidal effects.

The unequal spatial distributions in the three groups of organic micropollutants (PCB, PAH, and BHC) and the fecal sterol coprostanol within the sediments of the Husumer Aue and the adjacent Wadden Sea were interpreted by cluster analysis and principal component analysis. The regional patterns of PAH and PCB concentrations in sediments, algae and water are characterized by a decrease in concentrations from the zone of maximum turbidity to the sea. Further, the concentrations decrease from the tidal gully towards the tidal flats. The chlorinated pesticides alpha-BHC and gamma-BHC show an irregular distribution pattern which is dominated by a multiple input from intensively used agricultural land. The concentrations of coprostanol in sediments and algae indicate clearly the spatial distribution of fecal pollution. The spatial-temporal behavior of PCB and PAH, which are predominantly adsorbed on suspended sediments, results from the settling, resuspension and transport with the tidal currents of such sediments. This may be inferred from the temporal concentration profiles of water samples taken during a complete tidal cycle. (Author's abstract)
W85-04808

NUTRIENT BUDGETS FOR AGRICULTURAL WATERSHEDS IN THE SOUTHEASTERN COASTAL PLAIN,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
For primary bibliographic entry see Field 6G.
W85-04826

ACCUMULATION OF COPPER AND ZINC IN THE YELLOW WATER LILY, NUPHAR VARIEGATUM: RELATIONSHIPS TO METAL PARTITIONING IN THE ADJACENT LAKE SEDIMENTS,
Quebec Univ., Sainte-Foy.
P. G. C. Campbell, A. Tessier, M. Bisson, and R. Bougie.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 11, p 23-32, January, 1985. 5 Fig, 7 Tab, 35 Ref.

Descriptors: *Copper, *Zinc, *Water lily, *Bioaccumulation, *Lake sediments, Quebec, Macrophytes, Aquatic plants, Fate of pollutants, Heavy metals, Iron, Bioavailability.

Relationships between the partitioning of Cu and Zn in lake sediments and their availability to the yellow water lily, Nuphar variegatum, were examined downstream from a major Cu/Zn mining and smelting complex in Northwestern Quebec, Canada. At each of 13 sampling sites five N. variegatum individuals were collected, separated into stem and rhizome portions, and analyzed for total Cu and Zn. At the same sites, sediment cores were collected at the base of each plant; the 0- to 2-cm stratum was extruded, wet sieved (850 micro-m), and subjected to a sequential leaching procedure to determine the partitioning of Cu and Zn among various operationally defined geochemical fractions. Statistical analysis suggested that a significant portion of the Cu burden in N. variegatum was probably derived from the sediments, whereas the Zn content of the plant originated largely in the water column. The concentrations of Cu in the fractions most readily extracted from the sediment were the best indicators of Cu bioavailability in the sediment; normalization of these concentrations with respect to the Fe content of the sediment improved the relationship with rhizome Cu content suggestions that Fe play a protective role in regulating Cu bioavailability. (Author's abstract)
W85-04837

DISSIPATION OF PERMETHRIN IN LIMNOCORRALS,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
K. R. Solomon, J. Y. Yoo, D. Lean, N. K. Kaushik, and K. E. Day.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 1, p 70-76, January, 1985. 3 Fig, 5 Tab, 31 Ref.

Descriptors: *Limnocorrals, *Permethrin, *Fate of pollutants, Pesticides, Absorption, Lake sediments, Water chemistry, Lake St. George, Ontario.

A need for replicate and more realistic methods to evaluate the effects of pesticides in the aquatic ecosystem, has led to the investigation of the use of enclosures or limnocorrals. In order to develop a methodology for studying the effects of pesticides in enclosures and to determine the impact of the pesticide permethrin on the aquatic ecosystem, permethrin was applied to approximately 100-cu m limnocorrals in Lake St. George, a small mesotrophic lake in Ontario at concentrations of 500, 50, 5, and 0.5 micro-g/L. Permethrin dissipated from the water rapidly and approximated first-order kinetics in the first 8-12 d. Time taken for 50 and 90% dissipation ranged from 1.65 and 3.65 d, respectively, at 0.5 micro-g/L to 3.5 and 6.75 d, respectively, at 50 micro-g/L. Inter- and intra-seasonal replication of dissipation patterns was good. Rate of dissipation varied slightly with depth, normally being slower at greater depth. Absorption of permethrin to sediments was rapid, penetration was shallow, and disappearance was slow. There was an increase in the Secchi disk depth in the treated limnocorrals. Dissolved inorganic carbon decreased in all limnocorrals, including controls after treatment, suggesting precipitation of calcium carbonate which may act as a scavenging agent for permethrin in the water. The limnocorral offers more replicatability, repeatability, and realism than other systems and will become a useful tool for studying the effects of pesticides in aquatic systems. (Moore-IVI)
W85-04838

CHEMICAL SURVEY OF THE VOLTA ESTUARY,
Institute of Aquatic Biology, Achimota (Ghana).
For primary bibliographic entry see Field 2L.
W85-04854

ORGANOCHLORINE RESIDUES IN COMMON TERNS AND ASSOCIATED ESTUARINE ORGANISMS, MASSACHUSETTS, USA, 1971-81,
Massachusetts Audubon Society, Lincoln.
I. C. T. Nisbet, and L. M. Reynolds.
Marine Environmental Research, Vol. 11, No. 1, p 33-66, 1984. 1 Fig, 11 Tab, 93 Ref, 1 Append.

Descriptors: *Organochlorine pesticides, *Pesticide residues, *Terns, *Massachusetts, Fish, Mussels, Polychlorinated biphenyls, DDT, TDE, DDE, Dieldrin, Heptachlor epoxide, Chlordane, Urban areas, Land use, Industrial wastes, Distribution.

Organochlorine residues were measured in eggs of common terns Sterna hirundo at nine stations and in Atlantic silversides Menidia menidia at 11 stations in coastal Massachusetts, 1973-74. Tern eggs were sampled at one station from 1971 to 1981 and at another from 1973 to 1978. Mussels Mytilus edulis and various fish were sampled in 1975-76. PCBs were the predominant residues in all samples. DDE, TDE, DDT and HEOD (dieldrin) were detected in most samples of fish. HE (heptachlor epoxide), Alpha-chlordane, oxychlordane and HCB were also detected in most samples of tern eggs. Concentrations of DDE, TDE and PCBs in tern eggs were highly correlated with those in fish at the same stations. Concentrations of PCBs in tern lipids were about 10 times those in the lipids of their prey. Except for HCB, concentrations of organochlorines were highest in urban areas (Boston Harbor and Buzzards Bay) and lowest in remote areas (outer Cape Cod). In Buzzards Bay, levels of DDE, HEOD, HCB and PCBs declined significantly between 1971 and 1981. However, on outer Cape Cod, only PCBs clearly declined after 1973, and by 1976 most of the urban-rural differences in levels of other organochlorines had disappeared. The geographical patterns in pesticide residue levels were associated both with urban uses and with specific agricultural uses. The highest levels of PCBs were associated with industrial effluents at New Bedford and Boston. Hatching failure in common terns was associated with elevated residues of DDE in one sample, but population effects of DDE were only marginal after 1971. (Author's abstract)
W85-04861

MERCURY POLLUTION IN SEDIMENTS, BENTHIC ORGANISMS AND INSHORE FISHES OF HAIFA BAY, ISRAEL,
Israel Oceanographic and Limnological Research Ltd., Haifa.
H. Hornung, B. S. Krumgalz, and Y. Cohen.
Marine Environmental Research, Vol. 12, No. 3, p 191-208, 1984. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Mercury, *Sediments, *Benthos, *Fish, *Haifa Bay, *Israel, Heavy metals, Water pollution sources, Bays, Gastropods.

Total mercury concentrations were determined in surficial sediments, eleven species of benthic organisms and six species of fish from Haifa Bay, Israel. The results show that essentially all of the shallow water zone of the Bay receives anthropogenic mercury. A mercury-cell chlor-alkali plant was identified as the source of pollution. Surficial sediments in vicinity of the plant, containing up to 0.99 micro-g Hg/g dry weight, were up to 157 times enriched in mercury relative to an unpolluted area. Mercury levels in the benthic organisms reflected the levels in the sediments. Maximal concentrations reaching 38.7 and 18.2 micro-g Hg/g dry weight were found in the carnivorous gastropod mollusks Arcularia circumcinta and Arcularia gibbosula, respectively. In all fish species, specimens caught in Haifa Bay had higher mercury concentrations in the muscle tissue than specimens caught south of the Bay. A maximal value of 1.66 micro-g Hg/g wet weight was recorded in Diplodus sargus. (Author's abstract)
W85-04863

RADIOECOLOGICAL STUDIES OF ACTIVATION PRODUCTS RELEASED FROM A NUCLEAR POWER PLANT INTO THE MARINE ENVIRONMENT,
Lund Univ. (Sweden). Dept. of Radiation Physics.
M. Nilsson, S. Mattsson, and E. Holm.
Marine Environmental Research, Vol. 12, No. 3, p 225-242, 1984. 12 Fig, 2 Tab, 9 Ref.

Descriptors: *Radioactive wastes, *Nuclear powerplants, *Bioindicators, *Marine environment, Oresund, Seaweeds, Crustaceans, Fate of pollutants, Distribution, Cobalt radioisotopes.

The Barseback nuclear power plant, located on the Oresund sound between Denmark and Sweden, consists of two boiling water reactors. The release of radionuclides, mainly activation products, is quite low during normal operation. During the summer, when annual overhaul and partial refuelling take place, the discharge is much higher. Samples of seaweeds and crustaceans collected along the coast were analyzed for radionuclides. Seaweeds (Fucus vesiculosus, F. serratus, Ascophyllum nodosum and Cladophora glomerata) and crustaceans (Idothea and Gammarus) proven to be excellent bioindicators for radioactive corrosion products released from the nuclear power plant into the marine environment. These bioindicators have been used to map the spatial and temporal distribution of the released radioactivity. The activity has been followed up to 150 km from the power plant, and the decrease in activity concentration in the bioindicators with distance can be expressed by a power function. The variation with time of activity concentration reflects the amount of activity discharged from the power plant, with good resolution in time. The bioindicators exhibit different uptake patterns of the radionuclides detected. The crustacean Idothea showed variations in the Co-60 activity concentration between winter and summer. (Moore-IVI)
W85-04865

PHOSPHORUS, NITROGEN, AND CARBON CYCLING BY FISH POPULATIONS IN TWO SMALL LOWLAND RIVERS IN POLAND,
Lodz Univ. (Poland). Inst. of Environmental Biology.
T. Penczak.
Hydrobiologia, Vol. 120, No. 2, p 159-165, 1985. 6 Tab, 24 Ref.

Descriptors: *Fish, *Utrata River, *Ner River, *Poland, *Cycling nutrients, Carbon, Phosphorus, Nitrogen, Population density, Growth, Metabolism.

Fish were caught at 6 sites in the Utrata River, a tributary of the Bzura River in the Vistula drainage basin, and 3 sites in the Zalewka Brook, a tributary of the Ner River in the Warta drainage basin. Amounts of C, P and N consumed by fish populations at these sites were estimated. Phosphorus was assimilated two times more efficiently than carbon and nitrogen. No significant differences in the levels of C, P, and N were noted with relation to body length, sex, and season. The amount of C, P, and N consumed by fish populations at the sites depended mainly on fish density and fish diet. The results imply that fish populations are important in the cycling of these elements. On average, fish consumed 7.9 kg of carbon, 3.1 kg of phosphorus, and 6.6 kg of nitrogen to assimilate 1 kg of each of these elements into their body. Phosphorus was the most effectively used element for growth; the efficiency for nitrogen and carbon is two times lower. All elements are absorbed most efficiently by young fish. (Baker-IVI)
W85-04888

BIOLOGICAL AVAILABILITY OF METALS TO MARINE ORGANISMS,
Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab.
M. Waldichuk.
Marine Pollution Bulletin, Vol. 16, No. 1, p 7-11, January, 1985. 7 Ref.

Descriptors: *Metals, *Marine organisms, *Fate of pollutants, Fish, Aquatic life, Sediments, Minerals.

To have an impact on aquatic organisms, metals must be in a form that is biologically available to them. Metals in particulate form, both suspended in the water and in the sediments, are seldom available directly to aquatic organisms. The only exception to their biological unavailability is when the particulate metals are ingested by marine organisms and become solubilized in the acidic juices of the gut. Natural processes releasing metals from minerals are considered. Attention is also given to the physical characteristics of sediments and the distribution of metals biogeochemical processes in the sediments, mine tailings, sewages sludge and dredge spoils, effects of water characteristics, mode of uptake by marine organisms, and measurement of bioavailability of metals. (Baker-IVI)
W85-04891

PCBS, DDTS AND OTHER CHLORINATED HYDROCARBONS IN MARINE ORGANISMS FROM THE MEDITERRANEAN COAST OF ISRAEL,
Bioresearch Labs. Inc., Haifa (Israel).
R. Ravid, J. Ben-Yosef, and H. Hornung.
Marine Pollution Bulletin, Vol. 16, No. 1, p 35-38, January, 1985. 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Fate of pollutants, *Mediterranean Sea, *Fish, *Shellfish, *Chlorinated hydrocarbons, Pesticides, Polychlorinated biphenyls, Coastal waters, DDT, Organic compounds, BHC, Aldrin, Israel.

Commercially exploited species of fish and shellfish taken along the coast of Israel were examined for organochlorine residues to evaluate in the present state of concentration and to serve as a baseline for monitoring in the future. Organochlorines analyzed were DDT and metabolites, PCBs (Aroclor 1242, 1254, and 1260), BHC (alpha and gamma) and aldrin. For Mullus barbatus no differences in the pesticide concentrations in this species were found among the sampling stations. The correlation coefficient shows a positive relation in the concentration of DDTS with increasing length of fish. Upeneus moluccensis showed a higher concentration of pesticides in the Tel-Aviv area than at the other three stations. An inverse relation was noted between DDTs, PCBs and the total length of the fish. Saurida undosquamis showed a positive relationship between the concentrations of DDTs, PCBs and the total length of the fish. In about 25% of the Parapeneus longirostris specimens no pesticides were detected. There was no correlation between the concentrations of DDT and body length of Parapenaeus longirostris, but there was a significant negative correlation between the concentrations of PCBs and the body length. DDTs were found in all samples investigated and, except for one sample of Mullus barbutus, all samples included PCBs as well. BHC was found in 75% of the samples and aldrin only in 40%. (Baker-IVI)
W85-04894

RETRIEVAL OF MATERIAL FROM THE SURFACE MICROLAYER WITH SCREEN AND PLATE SAMPLERS AND ITS IMPLICATIONS FOR PARTITIONING OF MATERIAL WITHIN THE MICROLAYER,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 5A.
W85-04895

TRACE METAL AND PCB CONTENT OF MUSSELS (MYTILUS EDULIS) FROM THE SOUTHWESTERN BALTIC SEA,
Kiel Univ. (Germany, F.R.). Inst. fuer Meereskunde.
H. Moller, R. Schneider, and C. Schnier.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 633-647, 1983. 6 Fig, 2 Tab, 11 Ref.

Descriptors: *Mussels, *Polychlorinated biphenyls, *Trace metals, *Baltic Sea, Water pollution

sources, Heavy metals, Wastewater pollution, Marine environment, Fjords, Thorium, Uranium, Scandium, Iron.

Hydrographic pecularities, including slow water exchange with the North Atlantic and stable water stratification, amplify ecological problems in the Baltic Sea. The introduction of human wastes into such an ecologically unstable area is a far greater danger than waste disposal in other marine environments. The concentrations of polychlorinated biphenyls and 28 metals were determined in mussels from 32 stations in the southwestern Baltic Sea. Elevated levels of PCBs (up to 28 mg/kg lipids) were found in harbor areas, but the high percentage of lipid in the dry weight of soft parts of the mussels partly explain this. There were three areas in which several elements occurred at levels clearly above the average for the whole region. One was near the Kiel sewage outlet, where chromium, nickel, silver, cadmium, gold, and mercury were found at high concentrations. Increased levels of heavy metals in the outer Flensburg Fjord and in the vicinity of Fehmarn Sound seem to be due to natural geological formations. This is indicated by the presence of high concentrations of thorium, uranium, scandium, and some rare earth elements, which are not commonly found in anthropogenic wastewaters. Elevated levels of heavy metals were usually not present in mussels from fjord stations. Two exceptions involving iron may be due to rust leached from a lock gate of the Kiel Canal and to the addition of FeSO4 to the cooling water of the Kiel power plant. (Moore-IVI)
W85-04902

DECOMISSIONING OF MERCURY CELL CHLOR-ALKALI PLANTS IN CANADA,
Environmental Protection Service, Ottawa (Ontario).
I. McBeath.
Available from Environmental Protection Service, Ottawa K1A 1C8, Canada. Economic and Technical Review Report EPS 3-EP-83-5, November 1983. 57 p, 5 Fig, 1 Tab, 6 Append.

Descriptors: *Industrial wastes, *Chemicals wastes, *Mercury pollution, *Mercury, *Effluents, *Runoff, *Seepage, *Restoration, Chemical industry, Decontamination, Detoxification, Cleanup, Contamination, Dismantling, Canada.

This report reviews in detail the procedures followed by six companies in dismantling, decontaminating and restoring, or converting their mercury cell chlor-alkali plants. Methods used to confine mercury-contaminated wastes from these plants in secure burial sites are described. This report deals only with closure procedures, although the safety and health of the workers was also emphasized during discussions with plant personnel. At each plant the activities were planned to minimize the possible exposure to mercury and frequent regular personnel monitoring was undertaken even though the wearing of face masks was mandatory if the mercury concentration in the air was greater than 0.05 mg/cu cm. The monitoring also included urine testing. Emphasis was placed on spill prevention and prompt clean-up. Cell rooms were well ventilated and atmospheric monitoring for mercury was carried out. All of the closed and converted plants monitor for mercury in the effluents, runoff and seepages from the original plant sites and burial areas. If any increase in mercury releases and migration are noted, corrective action will be taken immediately. All mercury removed from the closed and converted plants was sold. The dismantling, decontaminating and restoring of plant sites varied from plant to plant depending upon the extent of mercury contamination, the topographical location and type of soil at the plant, and the availability of a salt cavern to the plant.
W85-04939

CHLOROPHENOLS AND THEIR IMPURITIES IN THE CANADIAN ENVIRONMENT: 1983 SUPPLEMENT,
Environmental Protection Service, Ottawa (Ontario).
P. A. Jones.
Available from Environmental Protection Service, Ottawa, Ontario K1A 1C8. Economic and Technical Review Report EPS 3-EP-84-3, March 1984. 93 p, 1 Fig, 7 Tab, 142 Ref, 4 Append.

Descriptors: *Canada, *Chlorophenols, *Industrial wastes, Industrial production, *Environmental effects, *Ecotoxicology, Environmental policy, Literature, Pest Control Products Act.

Since the publication of the Environment Canada report 'Clorophenols and Their Impurities in the Canadian Environment' many changes have occurred in the use patterns of chlorophenols, and many research studies have been undertaken. The current Canadian use patterns for chlorophenols and the associated regulations under the Pest Control Products Act, administered by Agriculture Canada, as well as results of relevant research on the chlorophenols as reported in the literature since 1980, have been documented in this supplement. An annotated historical review of chlorophenols in Canada has also been included. The earlier Environment Canada review on chlorophenols contained considerable information on polychlorinated dibenzo-p-dioxins and other impurities usually present in chlorophenols. The information presented in this supplement has been restricted to that on chlorophenols since recent reviews have dealt specifically with the polychlorinated dibenzo-p-dioxins and other related impurities. Major subject areas addressed in the chlorophenol supplements include those on; quantities in commerce, sources to the environment, levels and stability in the environment, ecotoxicology, and fate and mobility in the environment.
W85-04941

5C. Effects Of Pollution

IN VIVO EFFECTS OF CADMIUM ON SOME ENZYME ACTIVITIES IN TISSUES OF THE FRESHWATER CATFISH, HETEROPNEUSTES FOSSILIS,
D.A.V. Coll., Muzaffarnager (India). Dept. of Zoology.
K. V. Sastry, and Km. Subhadra.
Environmental Research, Vol. 36, No. 1, p 32-45, February, 1985. 7 Tab, 33 Ref.

Descriptors: *Cadmium, *Enzymes, *Toxicity, *Catfish, Fish tissues, Animal tissues, Fish physiology, Metals, Heavy metals, Water pollution effects.

Alterations in the activities of some enzymes in a freshwater catfish, Heteropneustes fossilis, have been examined in liver, kidney, intestine, ovary, gills, and muscles after exposure to 0.26 mg/liter of cadmium for 15, 30, and 60 days. The fish were hyperglycemic and hyperlactemic after 15 and 30 days of exposure. The liver and muscle glycogen content was depleted in the first two periods of exposure. In contrast, 60 days of cadmium treatment increased the glycogen content of the two tissues. Liver lactic acid level was elevated after 15 days. Muscle lactic acid content fell significantly after 15 and 60 days of exposure, but it was elevated after 30 days. Acid phosphatase activity was inhibited in liver, ovary, and gills but the enzyme activity increased in kidney and intestine. The activity of alkaline phosphatase decreased in liver, kidney, and intestine but elevation was recorded in ovary and muscles. In all three exposure periods, hexokinase activity of kidney and ovary was inhibited but the enzyme activity increased in intestine. Hexokinase showed elevation in liver, gills, and muscle after 15 and 30 days of exposure and inhibition after 60 days of exposure. The activity of xanthine oxidase decreased in liver and muscles and elevated in the rest of the tissues. Glutamate dehydrogenase fell significantly in intestive, ovary, and gills. The liver, kidney, and muscles the enzyme activity was elevated. Liver, intestine, gills, and muscles showed elevation in aminoacid oxidase activity. However, the enzyme activity was inhibited in kidney and in ovary. (Author's abstract)
W85-04434

HEAVY METAL TOXICITY TO MICROBE-MEDIATED ECOLOGIC PROCESSES: A REVIEW AND POTENTIAL APPLICATION TO REGULATORY POLICIES,
New York Univ., NY. Dept. of Biology.
H. Babich, and G. Stotzky.
Environmental Research, Vol. 36, No. 1, p 111-137, February 1985. 1 Tab, 162 Ref. EPA grant R808329.

Descriptors: *Heavy metals, *Toxicity, *Microorganisms, *Water pollution effects, *Regulations, Ecological effects, Policy making.

Microorganisms are sensitive to heavy metal pollution as are other components of the biota. However, most studies on the interactions between microbes and heavy metals have been conducted in synthetic media or in altered (e.g., sterilized) environmental samples and usually have used only single species. Few studies have evaluated the effects of heavy metals on the activities of natural heterogeneous microbial populations, both autotrophic and heterotrophic, in terrestrial and aquatic environments. These latter studies have shown that heavy metals inhibit primary productivity, nitrogen fixation, the mineralization of carbon, nitrogen, sulfur, and phosphorus, litter decomposition, and enzyme synthesis and activity in soils, sediments, and surface waters. The potential adverse effects of heavy metals on such microbe-mediated ecologic processes need to be incorporated into the methodologies used by regulatory agencies, such as the U.S. Environmental Protection Agency, to prepare environmental risk assessments which, in turn, are used to formulate environmental criteria, such as the Water Quality Criteria, and to evaluate the safety to the environment of exposure to 'new chemical substances,' as mandated by the U.S. Toxic Substances Control Act of 1976. To provide appropriate data that can be assimilated into regulatory policy, it is essential that microbial ecotoxicity tests be standardized, are neither costly nor difficult to train personnel to conduct, and produce data that can be quantitated. (Author's abstract)
W85-04435

PHYSICAL AND ECONOMIC IMPACTS OF SEDIMENTATION ON FISHING ACTIVITIES; NAM PONG BASIN, NORTHEAST THAILAND,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
S. H. Johnson, III, and S. Kolavalli.
Water International, Vol. 9, No. 4, p 185-188, 1984. 1 Fig, 3 Tab, 10 Ref.

Descriptors: *Reservoirs, *Sedimentation, *Watershed management, *Thailand, *Fishing, Economic aspects, Nonpoint pollution sources, Erosion control, Soil erosion, Forest management, Clear-cutting, Environmental effects.

Rapid economic development in Southeast Asia has led to the destruction of large areas of natural forests. Without proper land management and protection, intensification of economic activities has resulted in increased soil erosion. Physical and economic impacts of nonpoint pollution from erosion on the larger off-farm environment are considered. The focus is on the flow of suspended sediment into water channels and the resulting increased turbidity and sediment deposits within downstream reservoirs. Using dynamic models of the Nam Pong watershed in Northeast Thailand, the reservoir formed by the Ubolratana Dam, and the community of fishing families, the magnitude of actual economic losses resulting from forest clearing is determined. Long term environmental and economic implications and alternative management strategies are presented. (Baker-IVI)
W85-04448

EVALUATION OF EUTROPHICATION IMPACT IN PUBLIC WATER SUPPLY RESERVOIRS IN EAST ANGLIA,
C. R. Hayes, and L. A. Greene.
Water Pollution Control, Vol. 83, No. 1, p 42-51, 1984. 4 Tab, 1 Ref.

Descriptors: *Eutrophication, *Reservoirs, *Water quality control, *East Anglia, *England, Water

quality, Drinking water, Water supply, Economic aspects.

Problems, causes and effects of eutrophication along with possible control options are considered for 12 reservoirs in the Anglian Water Authority region. Sewage treatment, river management, reservoir management, water treatment and distribution are interlinked with eutrophication. To resolve the complex interdependent water quality issues requires sophisticated data handling techniques and the cooperation of both scientific and engineering disciplines. The long term influence of eutrophication on the wholesomeness of public supplies from Anglian lowland reservoirs is of concern. The cost penalities likely to be incurred by Anglian Water Authority as a consequence of lack of recognition or the blind eye approach are very considerable as evidenced by preliminary estimates of long-term capital expenditure on treatment works and their distribution systems to ameliorate discoloration problems. (Baker-IVI)
W85-04451

EFFECTS OF THE RECHARGE ON SEWAGE EFFLUENTS UPON THE QUALITY OF CHALK GROUNDWATER,
H. A. C. Montgomery, M. J. Beard, and K. M. Baxter.
Water Pollution Control, Vol. 83, No. 3, p 349-366, 1984. 6 Fig, 11 Tab, 14 Ref.

Descriptors: *Groundwater recharge, *Effluents, *Wastewater disposal, *Chalk aquifers, *England, Groundwater quality, Water quality control, Storativity, Transmissivity, Nitrogen removal, Organic matter.

In Southern England the chalk is well-fractured, fine-grained, soft limestone in which intergranular flow predominates. Values for unconfined chalk storativity are commonly in the range of 0.5-2% and of transmissivity 500-3000 sq m/day. Rates of movement in the unsaturated and saturated zones were studied to ascertain whether the removal processes observed in the USA for organic matter, nitrogen, and microbiological contaminants would also occur in the chalk. Special emphasis was laid on the detection of organic micropollutants. Results show that, with a slight reservation about trace organics, effluent recharge to the chalk is not only an acceptable method of disposal on water quality grounds but could perhaps be adopted more widely as a resource conservation measure. Provision of sewage treatment appears to be immaterial as regards the groundwater quality some hundreds of meters from the recharge site except in so far as nitrogen removal is prevented if conventional biological treatment is provided. Obviously effluent recharge could not be used in areas of major fissuring of the chalk. In the Southern Water Authority such areas are thought to be confined to parts of north-west Kent and the areas adjacent to and beneath the tertiary outcrop in Southern Hampshire and Sussex. (Baker-IVI)
W85-04462

EFFECTS OF MOTORWAY RUN-OFF ON THE ECOLOGY OF STREAM ALGAE,
North West Water Authority, Warrington (England). Rivers Div.
G. B. J. Dussart.
Water Pollution Control, Vol. 83, No. 3, p 409-415, 1984. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Algae, *Highways, *Runoff, Water pollution effects, Streams, Salt, Species diversity, Abundance.

The impact of motorway drainage on the algae of upland streams in northwest England is described. Seven small streams were investigated, together with an intensive survey of one of the streams. The study took place at the end of the winter so that the maximum possible impact of events such as road salting would be identifiable. The purpose was initially to identify impacts and not to investigate chemical or biological mechanisms. Analyses of variance showed that downstream of the motorway there were significant increases in number of algal species, algal abundance, species diversity and the relative abundance of filamentous organisms. The relative abundance of filamentous organisms was the only aspect to show a positive but tenuous correlation with road-catchment length. (Baker-IVI)
W85-04466

EFFECT OF METHYLENE CHLORIDE ON RESPIRATION AND ELECTRON TRANSPORT SYSTEM (ETS) ACTIVITY IN FRESHWATER SEDIMENT,
Guelph Univ. (Ontario). Dept. of Environmental Biology.
J. T. Trevors.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 239-245, February, 1985. 4 Tab, 9 Ref.

Descriptors: *Methylene chloride, *Respiration, *Sediment, *Water pollution effects, Oxygen, Carbon dioxide, Electron transport system, Microorganisms.

Methylene chloride caused very different effects in the sediment samples depending upon the method used to measure activity. Methylene chloride had no significant toxic effect during a 1 hour enzymatic assay of electron transport system (ETS) activity. Methylene chloride caused a stimulation of ETS activity at day 1 and 4 when compared with untreated controls. After 6 and 8 days, no significant inhibition or stimulation of activity was noted, whereas at day 11, a stimulation of activity was again noted. Methylene chloride significantly inhibited carbon dioxide evolution in the sediment. The effective concentration inhibiting carbon dioxide evolution by 50% after 7 days was estimated to be 11.7 micro-l/g. Oxygen uptake measured in the same sediment samples treated with methylene chloride indicated that it was being used as a substrate, and stimulated ETS activity and therefore oxygen uptake. Oxygen uptake was stimulated by similar concentrations ranging from 1.0 to 20 micro-l/g. Any investigation of non-toxic or toxic effects of pollutants on environmental processes should not rely on any single measurement of microbial activity. (Baker-IVI)
W85-04475

EFFECTS OF TRICHLOROACETIC ACID, A NEW CONTAMINANT FOUND FROM CHLORINATING WATER WITH ORGANIC MATERIAL, ON DRAGONFLY NYMPHS,
Massachusetts Univ., Amherst. Dept. of Environmental Sciences.
M. Correa, E. J. Calabrese, and R. A. Coler.
Bulletin of Environmental Contamination and Toxicology, Vol. 43, No. 2, p 271-274, February, 1985. 1 Tab, 7 Ref.

Descriptors: *Water pollution effects, *Trichloroacetic acid, *Dragonflies, Chlorination, Ammonia, Respiration, Aquatic insects, Larval growth stage, Toxicity.

Trichloroacetic acid (TCA) has been found after chlorination of water rich in organic matter. A study was undertaken to assess the effects of TCA on respiration and ammonia excretion rates of nymphs of the dragonfly Somatochlora cingulata, a widely used indicator organism. Oxygen consumption was markedly and progressively enhanced in Somatochlora cingulata as a result of the TCA treatment. Highly significant differences were found between controls and experimental animals exposed to TCA with the respiration rate at 1 mg/L being nearly double that of the controls. Ammonia excretion levels increased significantly in a dose-dependent manner as a result of TCA exposure. As with oxygen consumption, the average ammonia excretion rate at 1 mg/l was twice that of controls. While the mechanisms by which the TCA treatment caused significant increases in oxygen consumption and ammonia excretion remains to be elucidated, it is of interest that the physiological changes observed occurred at levels of environmental relevance (10-100 ppb) for only a single four hour exposure. (Baker-IVI)
W85-04478

SUBCHRONIC EFFECTS OF A MIXTURE OF 'PERSISTENT' CHEMICALS FOUND IN THE GREAT LAKES,
Montreal Univ. (Quebec). Dept. de Pharmacologie.
M. G. Cote, G. L. Plaa, V. E. Valli, and D. C. Villeneuve.
Bulletin of Environmental Contamination and Toxicology, Vol. 34, No. 2, p 285-290, February, 1985. 2 Fig, 4 Ref.

Descriptors: *Great Lakes, *Organic compounds, *Toxicity, *Standards, Aldrin, Dieldrin, DDT, DDE, Endrin, Heptachlor, Lindane, Methoxychlor, Mirex, Toxaphene, Arochlor, DEHP, MEHP, Dibutylphthalate, Chlordane, Sublethal effects.

The 1978 Great Lakes Water Quality Agreement establishes guidelines or objectives for a series of 'persistent' toxic substances that had been identified as contaminants in the Great Lakes ecosystem. The combined effects of these chemicals was studied in order to determine if the established guidelines permit some measrue of safety in a toxicological sense. The 15 chemicals studied were blended into a ground cube diet, at four different concentration levels. Chemicals used included aldrin, dieldrin, DDT, DDE, endrin, heptachlor, lindane, methoxychlor, mirex, toxaphene, arochlor 1254, DEHP, MEHP, dibutylphthalate, and chlordane. The mixtures were well tolerated by both male and female rats when consumed for 91 days. No dose-related toxicological changes were noted. Although food consumption was significantly lower for the females during week 12, body weight was not significantly affected. Males exhibited no such change. The levels of compounds fed in the study were 1 to 1000-fold multiples of the water quality objectives proposed for control of persistent chemicals found in the Great Lakes. (Baker-IVI)
W85-04479

BIODEGRADABILITY OF TWO PRIMARY ALCOHOL ETHOXYLATE NONIONIC SURFACTANTS UNDER PRACTICAL CONDITIONS, AND THE TOXICITY OF THE BIODEGRADATION PRODUCTS TO RAINBOW TROUT,
Shell Chemicals U.K. Ltd., London (England).
For primary bibliographic entry see Field 5D.
W85-04487

PHYTOPLANKTON IN A POLLUTED SUBARCTIC LAKE BEFORE AND AFTER NUTRIENT REDUCTION,
Laensstyrelsen, Ostersund (Sweden).
S. Holmgren.
Water Research, Vol. 19, No. 1, p 63-71, 1985. 2 Fig, 6 Tab, 44 Ref.

Descriptors: *Phytoplankton, *Lakes, *Subarctic zone, *Sweden, *Nutrients, Phosphorus, Biomass, Water chemistry, Eutrophic lakes, Species composition, Ecological effects, Chlamydomonas, Chlorophyta, Dictyosphaerium, Chromulina, Cryptomonas, Mallomonas.

Phytoplankton and water chemistry were studied in a eutrophic subarctic Swedish lake before and after nutrient reduction. Pollution started in 1964 and the lake had received about 4.5 tons of phosphorus by the time the treatment plant was built in 1974. After that only 18-20 kg P/yr entered the lake. Before nutrient reduction the phytoplankton consisted principally of three species, Dictyosphaerium pulchellum var. minutum, Chromulina cv. darlecarlica and Cryptomonas cv. ovata. Two years after the P-load was reduced Chlamydomonas spp and Mallomonas akrokomos predominated in the plankton and their dominance has been maintained during the period of study. Seasonal average phytoplankton biomass decreased from 11.2 g/cu m in 1973 to 2.9 g/cu m in 1980. Average seasonal total phosphorus concentrations decreased from 168 micro g/l in 1980. Average Secchi depth readings increased from 1.3 m in 1973 to 2.1 m in 1980. Blue-green algae never had any quantitative importance in the lake and no blooms were observed. (Author's abstract)
W85-04490

ORGANIC SULFUR COMPOUNDS AND POLYCYCLIC HYDROCARBONS TRANSFERRED TO OYSTER AND MUSSEL FROM PETROLEUM SUSPENSION; IDENTIFICATION BY GAS CHROMATOGRAPHY AND CAPILLARY MASS CHROMATOGRAPHY,

Okayama Univ. (Japan). Dept. of Public Health.
M. Ogata, and K. Fujisawa.

Water Research, Vol. 19, No. 1, p 107-118, 1985. 4 Fig, 2 Tab, 13 Ref. Ministry of Education Agency (Japan) grant 57035029.

Descriptors: *Mussels, *Oysters, *Mollusks, *Sulfur compounds, *Polycyclic hydrocarbons, *Hydrocarbons, *Chromatography, Mytilus, Water pollution effects, Seawater, Gas chromatography, Mass spectrometry, Benzothiophenes.

Organic sulfur compounds in oyster (Crassostrea gigas) and mussel (Mytilus edulis) maintained in a crude oil suspension in seawater were analyzed by a gas chromatography-mass spectrometry system. Crude oil used in this experiment was a mixture of light crude oil and zubea crude oil (4:1) with a specific gravity of 0.857. The oil was poured into a separation funnel with sea water and then shaken vigorously; after standing, the lower seawater layer was separated and added to the exposure tank. Capillary column gas chromatography-mass chromatography of extracts of the oyster and mussel showed the presence of organic sulfur compounds of alkyl benzothiophene (C2-C4), dibenzothiophene and alkyl dibenzothiophene (C1-C4). Coexistence of polycyclic aromatic hydrocarbons with organic sulfur compounds was found in oyster and mussel. Accumulation ratios were calculated from concentrations of organic sulfur compounds in the biota samples to those in the water samples. The concentrations in water were calculated from the height ratio in gas chromatogram and average concentrations before and after the change of oil suspension were used for calculation of the concentration factors. The time courses of concentration ratios of organic sulfur compounds in the oyster and the mussel were determined by gas chromatography connected with flame photometric detector. Generally, the ratios in oyster and mussel increased as the exposure time increased and complete tissue saturation was not achieved within the present exposure periods used. Mussels discharged organosulfur compounds quickly, while the oysters tended to retain them relatively longer. Half lives of the compounds were calculated to be 12.1 + or - 2.9 days in oyster and 4.1 + or - 1.6 days in mussel. The organic sulfur compounds identified in this experiment are recommended as markers of oil pollution in shellfish. (Collier-IVI)
W85-04496

EFFECTS OF POWER STATION COOLING WATER DISCHARGES ON AQUATIC ECOLOGY,

Central Electricity Generating Board, Leatherhead (England). Biology Dept.
G. D. Howells.

Water Pollution Control, Vol. 32, No. 1, p 10-17, 1983. 7 Fig, 2 Tab, 32 Ref.

Descriptors: *Water pollution effects, *Hydroelectric plants, *Thermal pollution, Cooling water, Temperature effects, Fish, Crustaceans, Insects, Annelids, Additives, Chlorine.

The major effects of biological/ecological significance which seem likely to arise at inland power station cooling water discharges are those relating to increased temperatures, chemical additives and chemical quality changes. In general lethal temperatures are significantly greater than those in receiving waters, and also in the discharge, so that the more subtle or long-term effects of sub-lethal temperatures have to be distinguished from other environmental influences. The toxicity of chlorine to different organisms reported shows wide variations, attributable to different species' sensitivity, and different experimental exposures. The maximum exposure period below which no mortality occurs for any concentration of chlorine is about one third of the period for 50% of the population to be killed. Experimental studies showed that Limnodrilus increased egg production as temperature was increased to 25 C, while Tubifex egg production was steady over the range 10-25 C. The greater abundance of sexually mature Limnodrilus is attributable to increased temperature. Population abundance and the size of animals for crustaceans were largest at locations most subject to organic pollution, with a larger proportion of animals completing their life cycle in less than a year at warmer locations. Consistent differences in fish catch were found between rivers, but not upstream and downstream of the discharges in any one year. A significant difference in size of fry at downstream sites was observed and attributed to a winter attraction to, and a summer movement away from heated reaches. (Baker-IVI)
W85-04507

CONCEPTUAL MODEL OF LAKE ACIDIFICATION,

Norges Landbrukshoegskole, Aas. Dept. of Agricultural Hydrotechnics.
O. Groterud.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 686-691, October, 1984. 3 Fig, 14 Ref.

Descriptors: *Lakes, *Acidification, *Finnemarka, *Norway, Model studies, Limnology, Water pollution effects, Air pollution, Water pollution sources, Aluminum, Leaching, Vegetation, Fish, Invertebrates.

A model is used to describe the acidification dynamics of lakes in Finnemarka, southern Norway with reference to atmospheric, terrestrial and limnic factors involved in the acidification process. The lakes examined were soft water lakes in an area underlain by granitic rocks with very shallow overburden. The oligotrophication of the lakes and chemical changes have been examined by means of sediment analyses. Sedimentary chlorophyll determinations were studied down to a depth of about 15 cm. Some other parameters also determined in the sediment layers in question include ignition loss, pH, Eh, phosphorus, iron, manganese, aluminium, and alkaline soluble silicon. Biological changes like fish extinction and invertebrate community structure in the lake may both affect the metabolism rate and possibly the lake acidity directly. These changes are induced by the increased leaching of aluminum from the catchment and the increased acidity of the lake water. Increased growth of mosses, fungi and periphytic algae are involved in a feed-back process with the acid lake water. This increased growth may also be a result of increased transparency in the lakes. Changes in the decomposition of organic acids will possibly affect lake acidity. In general, the limnic acidification with many feed-back mechanisms is liable to be less stable than the two other main acidification processes. For instance, a change in the vegetation cover of the catchment may induce a feed back mechanism in the limnic part, thus giving rise to a stronger acidification than its contribution should merit alone. (Baker-IVI)
W85-04531

CHANGES IN BASE CATION CONCENTRATIONS DUE TO FRESHWATER ACIDIFICATION,

Norsk Inst. for Vannforskning, Oslo.
A. Henriksen.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 692-698, October, 1984. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Acid lakes, *Acid deposition, *Base cations, *Cations, *Norway, Magnesium, Calcium, Lakes, Water pollution effects.

Under natural conditions, lithological components within a watershed are subject to weathering processes that consume hydrogen ions and release other cations. If the hydrogen ion input increases the weathering rate should increase, releasing more cations (such as calcium, magnesium, and aluminum) and giving higher concentrations of cations in the runoff water. In developing empirical models of lake response to atmospheric acidic inputs it is necessary to know how the concentration of non-marine Ca plus Mg (CM*) changes in lakewater as acid inputs are changed. Two approaches have been used, based on chemical data from 719 lakes in southern Norway with similar bedrock lithology, across a gradient in acid loading, as reflected by the non-marine sulfate concentration ($SO4^*$) in the lake. (1) Increases in CM* from increased weathering caused by increased $SO4^*$ should be nearly equal in lakes and drainage basins, grouped by similar elevation. Lakes with the lowest CM* at elevated $SO4^*$ in each group can have increased CM* by a maximum amount corresponding to the present concentration. A maximum increase factor of about 0.4 micro eq CM*/micro eq $SO4^*$ is derived. (2), A similar value is obtained from 486 lakes with pH < 5.0, assuming that H(+) and Al concentrations are negligible if HCO3(-) is present, and that an increase in $SO4^*$ is compensated by H(+), aluminum, and possibly increased CM*. This neglects $SO4^*$ used to compensate for lost HCO3(-). Both estimates of increased CM* caused by increased $SO4^*$ give maximum values. Effects of changed $SO4^*$ on pH may be calculated for a maximum or minimum pH change. Evaluation of available data do not clearly lead to the conclusion that the base cation concentrations really have increased in areas subjected to acid inputs. These trends will only be precisely determined with more extensive studies. (Collier-IVI)
W85-04532

DISSOLVED ORGANIC CARBON IN DANISH LAKES: CONCENTRATION, COMPOSITION, AND LABILITY,

Aarhus Univ. (Denmark). Botanical Inst.
M. Sondergaard.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 780-784, October, 1984. 3 Fig, 2 Tab, 12 Ref.

Descriptors: *Dissolved solids, *Organic carbon, *Denmark, *Lakes, Bacteria, Trophic level, Decomposition, Diel variation.

Dissolved organic carbon (DOC) is a major constituent of the carbon pool in aquatic environments. By bacterial activity the DOC is partly converted to particulate organic carbon and made available to higher trophic levels. An investigation of dissolved organic carbon was carried out in 14 lakes in Denmark. The lability of the DOC to bacterial decomposition was measured in four lakes as the decrease in concentration with time. Intensive, diel studies in five lakes were undertaken at different dates. Instantaneous concentrations of DOC are tabulated and plotted against the yearly pelagic primary production. A positive and significant correlation was noted. The lakes represent both drainage and seepage lakes, therefore one interpretation of the relationship is that the DOC is mainly of autochthonous origin and that an almost constant part of the production becomes refractory. A short water retention time and a high productivity would thus obscure the results. Lake Orn is the lake with the shortest retention time (19 days). The low concentration of DOC in Lake Orn thus can be explained by the lack of old and refractory DOC in the pool. Significant diel changes were only found at one occasion in Lake Mosso and in Lake Orn. Molecular weight separations indicate that only a minor part of the DOC was high molecular weight compounds. The major part was less than 700 Daltons and probably less than 300 Daltons. The most striking feature was the similarity of the elution patterns in 14 very different lakes and in samples collected at different seasons. (Baker-IVI)
W85-04540

DECLINE OF ZOOBENTHOS THROUGH FIVE DECADES OF EUTROPHICATION IN LAKE ESROM,

Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
P. M. Jonasson.

Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 800-804, October, 1984. 2 Fig, 2 Tab, 3 Ref.

Descriptors: *Benthic fauna, *Lake Esrom, *Denmark, *Eutrophication, Water pollution effects,

Wastewater pollution, Population dynamics, Mussels, Midges, Tubificids.

The oxygen uptake of zoobenthos, lethal effects of oxygen lack on respiration and growth retardation are examined. Changes in life histories and population dynamics are also recorded. Draining of tributaries through pipes resulted in increased eutrophication of the lake from 1956 onward. A total loading of 9,000 person equivalents (p.e.) polluted the lake. Untreated sewage, corresponding to 4,500 p.e. polluted the lake from 1961 to 1971. In 1968, 28,000 cu m of lumber also polluted the lake. Up to 1961 the zoobenthos community of the lake remained unaffected. During the period 1961-71, the midge Chironomus anthracius and the mussel Pisidium sp. were much reduced in numbers, while the turbificid Potamothrix hammoniensis remained unaffected. The total fauna 600 m from the sewage inlet was reduced in one year by 63% in numbers/sq m, but 3.5 km away the reduction was only 40% over a 10 year period. In 1982 the zoobenthos was greatly reduced: Potamothrix hammoniensis was reduced to 30.8%, C. anthracinus to 8.7% and Pisidium sp. to 0.06% of the average numbers before 1961, after another 10-year period with treated sewage (3,500 p.e.) and 10,000 cu m lumber in 1982. (Baker-IVI)
W85-04541

MACROPHYTES IN THE LOOSDRECHT LAKES: A STORY OF THEIR DECLINE IN THE COURSE OF EUTROPHICATION,
Limnologisch Inst., Nieuwersluis (Netherlands).
E. P. H. Best, D. de Vries, and A. Reins.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 868-875, October, 1984. 1 Fig, 2 Tab, 17 Ref.

Descriptors: *Macrophytes, *Lakes, *Eutrophication, *Loosdrecht Lakes, *Netherlands, Lake restoration, Water pollution effects, Aquatic plants.

The distribution of aquatic macrophytes in the Loosdrecht Lakes was studied as part of a base-line study before the lake restoration process. The present data are compared with older data and speculations on the future distribution are made. A rich macrophytic flora used to be present in the Loosdrecht area. Descriptions dating to 1941 mention local predominance of characeans, the distribution of Potamogetonaceae over large areas, and the presence of a diverse emergent flora. The survey for 1980-1982 indicated a significant decline, particularly in the submerged plants, which is attributed mainly to polluted inlet water. A recovery of the macrophytic flora is expected as a consequence of the better quality of inlet water in the near future. (Baker-IVI)
W85-04549

MODELLING EUTROPHICATION IN SHALLOW DUTCH LAKES,
Waterloopkundig Lab. te Delft (Netherlands).
F. J. Los, N. M. De Rooij, and J. G. C. Smits.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 917-923, October, 1984. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Eutrophication, *Netherlands, *Lakes, *Model studies, Phytoplankton, Oxygen, Nitrates, Phosphates, Mathematical models, Nutrients, Orthophosphates.

Eutrophication is an extremely complicated problem in the Netherlands, involving nutrient transports in rivers and nutrient transports to and from a lake's bottom in addition to biological and chemical processes in the lake. Mathematical models offer a possibility for an integrated approach. Two models are used: the BLOOM II, a phytoplankton model, and a biochemistry model, CHARON. Using the coupled model showed that the magnitude of the computed blooms expressed in chlorophyll units agrees well with the measurements, although the yearly averaged phytoplankton levels in the four lakes studied differ by a factor of ten. With some exceptions, the coupled model gives an accurate representation of the highly diversified annual patterns in the four cases. Computed values for the chemical species nitrate and oxygen in a lake agree very well with the measurements. Orthophosphate, however, tends to be underpredicted in 1980 and is strongly underpredicted in 1979. Computation of limiting factors and dominant phytoplankton species agree rather well with the measurements. (Baker-IVI)
W85-04551

OUTDOOR RECREATION - A NEW FACTOR DISTURBING LAKE ECOSYSTEMS, AS EXEMPLIFIED BY LAKE GIM, MAZURIAN LAKE DISTRICT,
Instytut Rybactwa Srodladowego, Olsztyn-Kortowo (Poland).
M. Bninska.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 978-981, October, 1984. 3 Tab, 10 Ref.

Descriptors: *Recreation, *Environmental effects, *Lake Gim, *Poland, Fish, Ecosystems, Camping, Eutrophication.

Lake Gim is located 25 km from the town of Olsztyn. The area of the lake is 175 ha and average depth is 7.6 m. The lake is intensively used for recreation. Fifty percent of the shore line (8600 m long) is occupied by various recreation sites and facilities. In 1979 they embraced 7 recreation centers belonging to various factories, 6 marked out tent camping sites, one scout camp and 112 private summer houses. In 1982 the number of the latter increased to 128. In 1979 there were on the average 26 tents daily at the marked out tent sites, while in 1982 this number increased to 72 tents daily throughout the season. In the period 1979 through 1982 loading of Lake Gimn with P originating from the recreational use amounted in successive years to: 0.2098 g/sq m /year in 1979, 0.2023 in 1981 and 0.2791 in 1982. Direct effect of the recreation upon lake loading with nutrients is confirmed by the results of chemical analyses of water. Near the recreation sites content of basic nutrients in water was much higher than at longer distances from the shore. These high loadings of lakes with nutrients, especially with P must affect fish stocks. Commercial fish catches in Lake Gim were examined from 1957 through 1981. The results show that Lake Gim is already in a state of advanced eutrophication, with initial symptoms of the ecosystem degradation. A clear succession in breaking down of particular groups of species is noted. Maximum catches were noted at the turn of 1960 to 1970, after which a constant decrease has been noted. The only direct impact on this lake has been recreational usage. (Baker-IVI)
W85-04557

EUTROPHICATION OF LAKE BALATON: MEASUREMENTS, MODELING AND MANAGEMENT,
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
S. Herodek.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1087-1091, October, 1984. 4 Fig, 11 Ref.

Descriptors: *Lake Balaton, *Hungary, *Eutrophication, Model studies, Water pollution control, Phosphorus removal, Lake management, Nutrients, Water quality, Tributaries, Wastewater pollution.

Lake Balaton has a surface area of 594 sq km but the mean depth is only 3.2 m. Its long shape can be divided into four successive basins. The Zala River flows into the first one, while the Sio Canal drains water from the last basin into the Danube River. It is important to maintain a high water quality in this lake as it is visited by two million tourists each summer. Productivity increased in all 18 sampling sets very regularly in a south-westward direction. The discharge of the sewage treatment plants were measured. The main sources of P in the western part of the lake are the tributaries, while in the eastern part they are the direct municipal sewage discharges. The transport between the basins is significant. The BAP (biologically available P) retention in the four basins is similar, ranging from 67 to 73% of the BAP loads, despite the increasing water residence times. In the more eutrophic parts of the lake the sedimentation rate must be much higher than in the less eutrophic ones. In Basin II the BAP load should be reduced to one third of the present level. P removal from the wastewater of the towns on the watershed of the basin started in 1983. Pollution due to liquid manure produced by large animal farms must be stopped by the end of the next year. Most of the sewage water from the recreational area of Basin III will be diverted outside the watershed within the next two years. In the case of Basin IV, the P removal at the two largest sewage treatment plants started in spring 1983, and all the other sewage will be diverted into the Sio Canal within the next two years. (Baker-IVI)
W85-04562

IMPACT OF NUTRIENT LOAD ON TOTAL BIOMASS AND SPECIES SUCCESSION IN LAKE SUWA, JAPAN,
MAXIMUS, Inc., McLean, VA.
K. L. Seip, and T. Satoh.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1142-1149, October, 1984. 7 Fig, 1 Tab, 32 Ref.

Descriptors: *Lake Suwa, *Japan, *Nutrient load, *Biomass, *Succession, Model studies, Wastewater treatment facilities, Nitrogen, Phosphorus, Species diversity, Algae, Eutrophic lakes.

Lake Suwa is a relatively small and shallow eutrophic lake situated in the Nagano prefecture of Japan. A sewage plant is under construction in the area and is partly in use. When completed it is estimated that 50% of the N and 70% of the P load to the lake will be eliminated. The sharp changes in the curves representing simulation results are probably more characteristic for bioassay experiments than for whole lake observations. For 1977 data an average chlorophyll a (chl-a) concentration of 85 mg chl-a/cu m was obtained with a peak value of about 204 mg chl-a/cu m. The temperature variations used in the simulations were extreme. Changes in biomass values corresponding to 10-20% reductions in nutrient inputs may easily be caused by temperature variations and thus mask effects of reductions in nutrients. Nutrient load to the lake has decreased since 1977, but the exact amount of the decrease is unknown. In 1981 and 1982 the maximum chl-a was down from 200 mg/cu m to about 90 mg/cu m. The dominant species of algae was unchanged. On the basis of chl-a measurements it is probable that a 30-40% reduction in nutrient loads has been obtained. If P is reduced more than N, the absence of significant stocks of green algae may be consistent with simulation results, but it would be anticipated that green algae would be more abundant as the sewage plant comes to completion in 1985. According to the simulation results, Lake Suwa was a threshold response type lake in 1977. Linear or global models are probably not sufficient for the description of such lakes. Even in the present model the description of the release of nutrients from the sediments must be improved. (Baker-IVI)
W85-04565

SUBSAMPLING PROGRAM FOR THE ESTIMATION OF FISH IMPINGEMENT,
Union Carbide Corp., Oak Ridge, TN. Computer Sciences Div.
J. J. Beauchamp, and K. D. Kumar.
Environmental Management, Vol. 8, No. 6, p 539-542, 1984. 3 Fig, 3 Ref.

Descriptors: *Impingement, *Fish, *Sampling, Powerplants, Intakes, Environmental effects.

Federal regulations require operators of nuclear and coal-fired power-generating stations to estimate the number of fish impinged on intake screens. During winter months, impingement may range into the hundreds of thousands for certain species, making it impossible to count all intake screens completely. Graphs are presented for determining the approprite 'optimal' subsample that must be obtained to estimate the total number impinged. Since the number of fish impinged tends

to change drastically within a short time period, the subsample size is determined based on the most recent data. This allows for the changing nature of the species-age composition of the impinged fish. These graphs can also be used for subsampling fish catches in an aquatic system when the size of the catch is too large to sample completely. (Author's abstract)
W85-04604

PREDICTION OF RED TIDE OCCURRENCE BY MEANS OF DISCRIMINANT ANALYSIS (IN JAPANESE),
Hiroshima Prefecture Fisheries Experiment Station, Ondo (Japan).
A. Ouchi.
Bulletin of the Japanese Society of Scientific Fisheries, Vol. 50, No. 10, p 1647-1651, October, 1984. 4 Fig, 3 Tab, 4 Ref.

Descriptors: *Red tide, *Discriminant analysis, *Prediction, *Hiroshima Bay, *Japan, Eutrophication, Dinoflagellates, Water quality, Nitrogen, Phosphorus, Salinity.

This study was made to explore the possibility of predicting the red tide by the discriminant analysis based on quality data of surface water in the northern part of Hiroshima Bay. All the data (N=526) obtained from 1976 to 1982 were divided into two groups, non-red tide group and red tide group, according to a critical value 250 micro-g/l for the PON concentration. Then, the discriminant analysis was performed using six variables (WT, SAL, TDP, DIN, DON, PON). The results obtained are as follows. 1) Mahalanobis' distance was 8.85 and the probability of misclassification was evaluated to be 6.8%. The rate of misclassification was actually 4.2% for 526 data. 2) When a station is classified into the non-red tide group and its misclassification probability becomes more than 25%, or less than 5%, there is a great tendency for red tide to occur around the station. In the latter case, salinity ranged from 5.1 to 15.1% or TDP was 45-141 micro-g/l, DIN was 439-618 micro-g/l respectively, and the red tide actually occurred at a rate of 52%. 3) When a station belonging to the red tide group has the misclassification probability more than 17%, there is a great tendency for red tide to disappear. 4) This method has a great advantage in judging a red tide occurrence, because only one misclassification probability is used instead of six variables. (Author's abstract)
W85-04605

SOME REMARKS ON THE ECOLOGY OF ALGAE IN HEATED WATERS (UWAGI O EKOLOGII GLONOW W WODACH PODGRZANYCH),
Instytut Rybactwa Srodladowego, Piaseczno (Poland). Zaklad Rybactwa Stawowego.
J. Sosnowska.
Wiadomosci Ekologiczne, Vol. 30, No. 2, p 131-142, 1984. 1 Fig, 36 Ref.

Descriptors: *Heated water, *Algae, *Thermal pollution, *Water pollution effects, Cooling water, Thermal powerplants, Water temperature, Chlorination, Turbines, Phytoplankton, Aquatic plants, Periphyton.

The effect of water temperature and mechanical factors accompanying the discharge of heated water on the algae in various water bodies are reviewed. Discharge, especially in cold months, may cause changes in life cycles of aquatic organisms. A temperature increase, up to 25-30 C, usually stimulates the intensity of phytoplankton and periphyton growth. The maximal temperatures, above which the species composition of algae is usually reduced, are from 32-36 C, except for blue-green algae. Water temperatures exceeding 30 C usually inhibit the growth of phytoplankton. Rapid changes in water temperature in algal cultures results in the appearance of abnormally large or deformed individuals. Changes in phytoplankton composition due to an increase in water temperature are as follows: at 20-30 C Bacillariophyceae dominate (in number of species), at 30-35 C Chlorophyta dominate, and over 35 C Cyanophyta dominate. With a temperature drop from 40 to 18 C Chlorophyta appear first, then Bacillariophyceae. The main reaction to stress is a reduction of the numbers of more sensitive algal species. Even large changes in the thermal regime of water rarely cause a complete disappearance of a species. In the cooling systems of thermal power stations, 42-72% of individuals of sensitive species are destroyed (mainly at 30-35 C and above). Due to greater reproduction of cells surviving at high temperatures, the algal communities quickly attain their earlier abundance. Effects of turbines at thermal power plant on different taxonomic groups of algae may change the qualitative composition of communities. Chlorination of water at the heated water discharged usually weakens the cell photosynthesis and reduces the number of algal communities with an unchanged number of species. (Moore-IVI)
W85-04609

WATERBORNE OUTBREAK OF HEPATITIS A IN MEADE COUNTY, KENTUCKY,
Kentucky Dept. for Health Services, Frankfort.
G. H. Bergeisen, M. W. Hinds, and J. W. Skaggs.
American Journal of Public Health, Vol. 75, No. 2, p 161-164, February, 1985. 2 Fig, 4 Tab, 10 Ref.

Descriptors: *Hepatitis, *Meade County, *Kentucky, *Viruses, *Public health, *Drinking water, Epidemiology, Springs, Groundwater pollution, Rainfall.

Serologic testing was used to establish the diagnosis of Hepatitis A (HA) infection during an epidemic of the disease. In November 1982, Meade County, Kentucky health officials noted a sudden increase in the incidence of hepatitis A. Using a standardized interview of 73 cases (68 serologically confirmed), and 85 controls (all negative for antibody to hepatitis A virus), the most important risk factor identified was household use of untreated water from a single spring. Many Meade County residents obtain water from untreated sources and at the time of the outbreak almost everyone who used spring water got their water from Buttermilk Falls (BF). The water was pumped into trucks and hauled to homes for storage in cisterns. A cistern water source was reported by 56 cases (77%) and 40 controls (47%). Consumption of cistern water, adjusted for age and sex, was significantly associated with HA. Consumption of BF water, specifically, was significantly associated with with HA; a significant dose-response relationship was demonstrated for consumption of unboiled BF water and risk of developing HA - the more unboiled BF water consumed, the greater the risk of getting HA. Water samples taken from the spring during the outbreak were contaminated with fecal coliforms. Sinkholes in the limestone rock formations of Mead County are used for the dumping of human and animal wastes. Effluent from the underground systems appears at the surface as springs such as Buttermilk Falls. It is notable that rainfall for the county in the last four months of 1982 was 15.33 inches (3.37 inches above normal) suggesting the possibility of extensive washout of underground pools of contaminated water. (Collier-IVI)
W85-04658

FACTORS AFFECTING CLARITY OF NEW ZEALAND LAKES,
Ministry of Works and Development, Hamilton (New Zealand). Water and Soil Science Centre.
For primary bibliographic entry see Field 2H.
W85-04670

EFFECTS OF FOUR HEAVY METALS ON SURVIVAL AND HATCHING RATE OF ARTEMIA SALINA (L.),
Athens Univ. (Greece). Zoological Lab. and Museum.
E. Kissa, M. Moraitou-Apostolopoulou, and V. Kiortsis.
Archiv fur Hydrobiologie, Vol. 102, No. 2, p 255-264, December, 1984. 1 Fig, 5 Tab, 31 Ref.

Descriptors: *Heavy metals, *Toxicity, *Life stages, *Brine shrimp, Cadmium, Chromium, Nickel, Cobalt, Eggs, Nauplii, Metals, Water pollution effects.

Acute lethalities to nauplii of Artemia salina were compared for four heavy metals (cadmium, chromium, nickel, cobalt) commonly discharged into coastal waters; LC50 48 hours were determined for three day old naupiii. Sublethal effects of low concentrations of these metals on the hatching rate of Artemia cysts were compared as well. Acute toxicity tests indicated an increased tolerance of Artemia to three (Cd, Co, Ni) of the four tested metals (LC50 48h, in mg/l): Cd: 159.611 + or - 0.176; and Co: 1.71.66 + or - 0.201. Artemia has not demonstrated such a high tolerance to chromium: LC50 48h = 7.911 + or - 0.066. Artemia eggs have shown a higher sensitivity to metals (except chromium) compared with Artemia nauplii: concentrations from 1/15 to 1/30 of the LC50 48h caused usually a 50% reduction of the hatching rate. For chromium a concentration of about the LC50 48h caused halving of the hatching rate. Chromium probably has a different toxic action when acting on survival and on hatching. (Collier-IVI)
W85-04674

ECOLOGY OF MEIOFAUNA IN AN ORGANICALLY POLLUTED ESTUARINE MUDFLAT,
Groningen Rijksuniversiteit (Netherlands). Biological Research Ems-Dollart Estuary.
For primary bibliographic entry see Field 2L.
W85-04676

MICROELEMENT CONTENT OF SOME SUBMERGED AND FLOATING AQUATIC PLANTS,
Botanikai Kutatointezete, Vacratot (Hungary).
For primary bibliographic entry see Field 2H.
W85-04678

CONFINEMENT AND WATER QUALITY-INDUCED STRESS IN LARGEMOUTH BASS,
National Fish Hatchery and Technology Center, San Marcos, TX.
G. J. Carmichael, J. R. Tomasso, B. A. Simco, and K. B. Davis.
Transactions of the American Fisheries Society, Vol. 113, No. 6, p 767-77, November, 1984. 4 Fig, 3 Tab, 53 Ref.

Descriptors: *Stress, *Bass, *Fish, *Water pollution effects, Fish physiology, Water temperature, Blood chemistry, Fish handling facilities, Thermal stress.

Plasma values of corticosteroids, glucose, chloride, and osmolality were determined in large-mouth bass Micropterus salmoides under various environmental conditions. No differences were observed in quiescent fish due to sex, size, time of day, or the types of holding facilities tested (tanks, raceways, ponds). Differences were observed in plasma glucose, chloride, and osmolality values among fish acclimated to 10, 16, and 23 C. Abrupt temperature changes caused elevations in plasma corticosteroid and glucose concentrations and reduced plasma chloride and osmolality. Confinement in a net, for up to 48 hours, caused elevated glucose and corticosteroids and reduced chloride and osmolality values. After 48 hours of confinement, fish required up to 14 days to recover normal plasma characters. Generally, short-term exposure to poor water quality (high concentrations of CO2 and NH3, and low concentrations of dissolved oxygen) altered plasma corticosteroids and glucose but had little effect on plasma chloride or osmolality. Net confinement plus poor water quality caused additional stress. Plasma glucose and corticosteroid values were good indicators of stress during application of acute stressors whereas chloride and osmolality were useful indicators of long-term stress and patterns of recovery after stressors were removed. (Author's abstract)
W85-04680

EFFECTS OF FREE AND COMBINED CHLORINE AND EXPOSURE DURATION ON RAINBOW TROUT, CHANNEL CATFISH, AND EMERALD SHINERS,
Wisconsin Univ.-Milwaukee. Center for Great

Lakes Studies.
A. S. Brooks, and J. M. Bartos.
Transactions of the American Fisheries Society, Vol. 113, No. 6, p 786-793, November, 1984. 1 Fig, 1 Tab, 24 Ref. Electric Power Research Institute contract RP 1435-1.

Descriptors: *Chlorine, *Water pollution effects, *Trout, *Shiners, *Catfish, *Fish, Toxicity, Hypochlorous acid, Chloramine, Hypochlorite, Water treatment.

Laboratory bioassays to determine the acute toxicity of monochloramine, dichloramine, hypochlorous acid, and hypochlorite ion to emerald shiners Notropis atherinoides, channel catfish Ictalurus punctatus, and rainbow trout Salmo gairdneri were conducted. Four exposure regimes typical of chlorination schedules at operating steam electric power plants were used. Fish were exposed for single 15-minute, 30-minute, 120-minute, and 4 x 30-minute periods. Based on median lethal concentrations (LC50s), the nominal solution of hypochlorous acid was the most toxic, followed closely by the solution dominated by dichloramine; nominal monochloramine and hypochlorite ion solutions had a third to a quarter the toxicity of the other two. On the average, emerald shiners were 1.8 times more sensitive than channel catfish and 3.3 times more sensitive than rainbow trout to the four forms of chlorine. The fish were most tolerant of chlorine during short-duration exposures and least tolerant during the continuous 120-minute exposures. The differences in toxicity noted among the chlorine forms suggest that, when chlorination regimes and regulations are established, careful attention should be paid not only to total residual chlorine but to both the chlorine forms and fish species present and the duration of exposure. (Author's abstract)
W85-04681

THERMAL MORTALITY PREDICTION EQUATIONS FOR ENTRAINABLE STRIPED BASS,
EA Engineering, Science, and Technology, Inc., Middletown, NY.
R. J. Kellogg, R. J. Ligotino, and S. M. Jinks.
Transactions of the American Fisheries Society, Vol. 113, No. 6, p 794-802, November, 1984. 1 Fig, 2 Tab, 23 Ref.

Descriptors: *Thermal pollution, *Mortality, *Bass, *Model studies, Life stages, Eggs, Larvae, Juveniles.

Thermal mortality prediction equations based on a logistic regression model were developed for eggs, for yolk-sac larvae, and for postyolk-sac larvae plus early juveniles of striped bass Morone saxatilis. Exposure temperature, exposure duration, acclimation temperature, and fish size were important explanatory variables. Mortality increased as test temperature and exposure duration increased and decreased as acclimation temperature and size increased. In addition to these main variables, interaction terms significantly improved the performance of the equations for yolk-sac larvae and for postyolk-sac larvae plus early juveniles. These mortality models can be used to make predictive assessments of the thermal component of entrainment mortality or to help determine power plant operating conditions that minimize the entrainment impact. (Author's abstract)
W85-04682

MANATEE USE OF POWER PLANT EFFLUENTS IN BREVARD COUNTY, FLORIDA,
Fish and Wildlife Service, Gainesville, FL. Denver Wildlife Research Center.
S. H. Shane.
Florida Scientist, Vol. 47, No. 3, p 180-187, Summer 1984. 3 Fig, 1 Tab, 16 Ref. Florida Power and Light Co contract 61552-86540.

Descriptors: *Manatees, *Mammals, *Powerplants, *Thermal pollution, *Indian River, *Florida, Heated water, Water pollution effects, Ecological effects.

The relationship between manatees and power plants was investigated at 2 power plants on the Indian River in Brevard County, Florida from January 1978-February 1980. Manatee presence in the power plant effluent zones was correlated with cold air and water temperatures. When air temperatures were below 16 C most manatees in the county were found in the effluent zones. Manatees in the effluent zones move with the wind-blown warm water plume, demonstrating a sensitivity to small changes in water temperature. Some individuals were frequently resighted at 1 plant, while others moved between the 2 plants. Because industrial warm water sources are less reliable than natural warm water refuges, it is recommended that no new artificial warm water effluents be constructed north of the species' traditional winter range. (Author's abstract)
W85-04696

OCCURRENCE OF DNA IN RIVER SEDIMENT: ITS MEANING AND RELATIONS WITH BENTHOS RESPIRATION, ORGANIC LOAD AND MACROINVERTEBRATES BIOMASS,
Savoie Univ., Chambery (France). Lab. d'Ecologie.
D. Fontvieille, B. Cazelles, and M. Fabre.
Ergebnisse der Limnologie, Vol. 19, p 91-100. December, 1984. 2 Fig, 4 Tab, 18 Ref.

Descriptors: *Deoxyribonucleic acid, *River sediments, *Sediments, *Respiration, *Macroinvertebrates, *Biomass, *Organic load, Carbon dioxide, Water pollution effects, Microorganisms.

DNA, total organic matter and respiration (CO2 production), were measured in the upper part of the sediments of a polluted brook in four stations below the input of a pigsty waste. From the relationship between DNA concentrations and CO2 production, it seems that the respiration originates more from microorganisms than from macroinvertebrates especially in stations where the benthic organic load is low. Some preliminary experiments are related dealing with the decomposition rate of DNA in sediments. The fast decomposition of free DNA (dissolved) in conditions partly natural is well demonstrated using the HOECHST 33258 fluorimetric method. On the contrary, the evidence of the decomposition of cell-walled DNA using the diphenylamine method appears only for 20% of the initial quantity during 40 hours. (Author's abstract)
W85-04699

EFFECT OF SOME HEAVY-METALS ON GLUCOSE ASSIMILATION IN POLLUTED WATERS,
Landesanstalt fuer Umweltschutz Baden-Wuerttemberg, Karlsruhe (Germany, F.R.).
M. W. Banoub.
Ergebnisse der Limnologie, Vol. 19, p 295-302, December, 1984. 6 Fig, 2 Tab, 17 Ref.

Descriptors: *Heavy metals, *Glucose, *Bacterial physiolgy, *Water pollution effects, Isotope studies, Mercury, Cadmium, Copper, Lead, Chromium, Metals, Toxicity.

The use of labelled glucose C-14 assimilation by the heterotrophic flora in natural and polluted waters was investigated. The effect of added concentrations of heavy metals Hg, Cu, Cd, Pb, and Cr on glucose assimilation was studied. Toxicity decreased with each metal in the above order, with wide variation in the response to each metal depending on the metabolic activity, the organic load as well as a probable natural adaptation to heavy metals by the different types of water. Pre-exposure to higher metal concentrations in the laboratory increased the metal toxicity. Efforts taken to normalize variations in metal toxicities in different waters on the basis of their Vmax and DOC may help in broad ranges. The values of EC 50 and EC 80 obtained here, apart from the varying types of water and their floras, lie within the range of mono-culture methods. Deviations from predicted metal-toxicities may be a valuable indicator of previous metal pollution. (Author's abstract)
W85-04705

TOLERANCE TO AND UPTAKE OF LEAD IN THE GREEN MUSSEL, PERNA VIRIDIS (L.),
National Univ. of Singapore. Dept. of Zoology.
W. H. Tan, and L. H. Lim.
Aquaculture, Vol. 42, No. 3/4, p 317-332, December 1, 1984. 3 Fig, 4 Tab, 35 Ref. NUS grant RP4/76.

Descriptors: *Lead, *Mussels, *Toxicity, *Mollusks, *Heavy metals, Metals, Animal tissues, Water pollution effects.

The acute toxicity of lead to the green mussel, Perna viridis, was studied. The median tolerance limit (Tlm) at 168 h was found to be 4.46 mg/l Pb(2+) for mussels with a shell length of 3-4 cm. Lead concentrations in the whole soft parts of P. viridis were determined after the animals had been exposed for 1, 2, 5 and 7 days to the metal at the above concentration with salinity maintained at 30 + or - 1% S and temperature at 26 + or - 1 C. The uptake was found to be linear with time. After 7 days, the average lead concentration in the tissues was 3495.5 micro g/g dry weight, giving a concentration factor of 784 and showing that P. viridis can concentrate the pollutant to a marked degree over the ambient level. The results emphasize the need to monitor heavy metal levels in P. viridis and other bivalves that are eaten to ensure that they are not potentially dangerous and to assist in site selection for aquaculture enterprises. (Author's abstract)
W85-04708

EVOLUTION OF THE COMMUNITY AT A STATION EXPOSED TO SEWAGE (MARSEILLE-CORTIOU) (EVOLUTION DU PEUPLEMENT D'UNE STATION SOUMISE A DES APPORTS D'EAUX D'EGOUT (MARSEILLE-CORTIOU)),
CICESE, P.O. Box 4844, San Ysidro, CA 92073.
A. Jorajuria.
Tethys, Vol. 11, No. 2, p 105-109, 1984. 1 Fig, 5 Tab, 15 Ref.

Descriptors: *Water pollution effects, *Marseille, *France, *Huveaune River, Benthos, Species composition, Wastewater pollution, Ecological effects.

Untreated wastewater of the town of Marseille (France) is diverted to the Cortiou station by means of large sewer; the highly polluted waters of a coastal river, the Huveaune, have been diverted to the sewer which now drains a basin of 603 km and one and a half million population equivalents. Surveys of the soft bottom benthic community in a station exposed to the Marseille-Cortiou outfall shows a change towards total destabilization of its structure over a two year interval. This results in a significant quantitative and qualitative reduction of species characteristic of various communities or of the substrate, and their replacement by opportunistic species. Further analysis would permit understanding of to what extent characteristic species in a disturbed environment would correspond to the maintenance of specific physico-chemical characteristics of a biotope. (Collier-IVI)
W85-04709

EFFECT OF POLLUTION ON THE COASTAL WATERS OF THE RED SEA IN FRONT OF JEDDAH, SAUDI ARABIA; 1. ENVIRONMENTAL CONDITIONS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
A. K. A. Behairy, and M. A. H. Saad.
Tethys, Vol. 11, No. 2, p 111-117, 1984. 5 Fig, 1 Tab, 18 Ref.

Descriptors: *Water pollution effects, *Red Sea, *Jeddah, *Saudia Arabia, *Coastal waters, Dissolved oxygen, Wastewater pollution, Water temperature, Air temperature, Hydrogen sulfide, Hydrogen ion concentration, Photosynthesis, Anaerobic conditions, Salinity.

Variations of some environmental conditions in the coastal Red Sea waters in front of Jeddah, which continuously receive untreated domestic wastes, were studied. The slight decrease in the bottom

water temperatures coincided with the shallowness of the study area. The lowest air and average water temperatures were recorded in January and the highest in October. Dissolved oxygen (DO) was depleted by waste disposal, and H2S was produced due to the anaerobic bacterial decomposition of the accumulated decayed organic wastes. The highest regional average DO values were found at locations relatively further away from pollution sources, where the photosynthetic activity has increased as indicated by the highest regional average Secchi values. The lowest regional average pH values found near the waste outfalls are mainly related to the direct effect of pollution, the remarkable decrease in the concentrations of dissolved salts due to dilution by effluents, and the great decrease in photosynthetic activity as a result of the highest turbidity. The highest average salinity values generally found in October and April coincided with the increase in the rate of evaporation brought about by elevation of temperature. (Author's abstract)
W85-04710

EFFECT OF POLLUTION ON THE COASTAL WATERS OF THE RED SEA IN FRONT OF JEDDAH, SAUDI ARABIA; 2. NUTRIENT SALTS,
King Abdulaziz Univ., Jeddah (Saudi Arabia). Faculty of Marine Science.
A. K. A. Behairy, and M. A. H. Saad.
Tethys, Vol. 11, No. 2, p 119-125, 1984. 4 Fig, 1 Tab, 20 Ref.

Descriptors: *Coastal waters, *Red Sea, *Jeddah, *Saudi Arabia, *Nutrients, Wastewater pollution, Seasonal variation, Nitrate, Nitrite, Silicate, Phosphate, Denitrification.

Variations of nutrient concentrations in the coastal Red Sea waters in front of Jeddah, which continuously receive untreated sewage wastes, were studied. The increase or decrease in the values of each nutrient was found to depend upon certain factors. The seasonal variations in the average values of each nutrient at stations near the waste disposal are principally related to variations in the discharge rate of sewage wastes. However, the seasonal variations at locations relatively further away from pollution sources are mainly attributed to the different conditions responsible for increasing or decreasing the nutrient content in the different seasons. The considerably highest regional average values of nitrite, phosphate and silicate at locations in the vicinity of waste outfalls coincided with the direct additions of large loads of these nutrients from sewage effluents. However, the regional average nitrate values at these stations were noticeably low, due to the anoxic conditions where a remarkable part of nitrate discharged by sewage wastes was reduced to nitrite and ammonia by denitrifying bacteria in depletion of dissolved oxygen. The remarkably high average value of each nutrient calculated for the study area during the investigation period is due to the effect of pollution and the limited exchange between the waters of the study area and the open sea. (Author's abstract)
W85-04711

COPPER COMPLEXATION AND TOXICITY TO DAPHNIA IN NATURAL WATERS,
Canada Centre for Inland Waters, Burlington (Ontario).
U. Borgmann, and C. C. Charlton.
Journal of Great Lakes Research, Vol. 10, No. 4, p 393-398, 1984. 1 Fig, 1 Tab, 12 Ref.

Descriptors: *Toxicity, *Copper, *Daphnia, *Metals, *Water pollution effects, Tris, Bioassays.

Toxicity of copper to Daphnia magna in artificial medium, artificial medium plus algae, and natural water from Hamilton Harbour and Lake Ontario was determined, with and without added Tris, in order to test the assumption that free cupric ion concentrations are the same in equivalently toxic media even when total copper concentrations vary. Free cupric ion concentrations were calculated from the increase in the total copper concentration tolerated after Tris addition and from cupric ion electrode measurements. Copper toxicity was greatest in inorganic medium, lowest in inorganic medium plus algae and in Hamilton Harbour water, and intermediate in lake water. However, after Tris addition, toxicity was greatest in lake water and lowest in inorganic medium and inorganic medium plus algae. Both the bioassay and electrode data indicate that free cupric ion concentrations differ in different test waters when toxicity is the same. Free metal concentrations do not, therefore, provide a good measure of copper toxicity for Daphnia in natural waters. (Author's abstract)
W85-04716

CONTENT AND CHEMICAL FORM OF MERCURY AND SELENIUM IN LAKE ONTARIO SALMON AND TROUT,
Rochester Univ., NY. Dept. of Radiation Biology and Biophysics.
C. J. Cappon.
Journal of Great Lakes Research, Vol. 10, No. 4, p 429-434, 1984. 1 Fig, 4 Tab, 42 Ref.

Descriptors: *Mercury, *Selenium, *Heavy metals, *Lake Ontario, *Salmon, *Trout, *Fish physiology, Animal tissues, Bioaccumulation, Trace metals, Water pollution effects.

The content and chemical form of mercury and selenium were determined in the edible tissue of salmon (coho, chinook) and trout (lake, brown) taken offshore from Lake Ontario near Rochester, New York. For all species, total mercury content ranged from 0.3 to 0.8 micro g/g (fresh-weight), which is similar to concentrations commonly found in canned tuna. Most of the total mercury (63 to 79 percent) was present as methylmercury, the remainder being divalent inorganic mercury. For all species, 6 to 45 percent of the total selenium content was present as selenate (SeVI), the remainder being selenite (SeIV) and selenide (SeII). On a molar basis, total selenium content usually exceeded that of total mercury. Samples of smoked and unsmoked brown trout fillets were also examined. Based on the results of this study there is no immediate human health hazard from mercury and selenium. However, there is a need to report specific chemical forms of these metals in Lake Ontario salmonid fishes so that elevated concentrations can be better evaluated. (Author's abstract)
W85-04717

ENVIRONMENTAL IMPACT OF TWO, ADJACENT, HAZARDOUS WASTE DISPOSAL SITES IN THE NIAGARA RIVER WATERSHED,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Jaffe, and R. A. Hites.
Journal of Great Lakes Research, Vol. 10, No. 4, p 440-448, 1984. 4 Fig, 1 Tab, 7 Ref. EPA grant 808961.

Descriptors: *Hazardous waste disposal, *Love Canal, *Niagara Falls, *New York, *Niagara River, Halogenated organics, Fate of pollutants, Path of pollutants, Water pollution sources, Sediments.

Sediment core samples were taken from the Niagara River at locations adjacent to the Love Canal and the 102nd Street dumps, two hazardous waste disposal sites in the City of Niagara Falls, New York. The samples were analyzed by capillary gas chromatographic mass spectrometry, and a variety of halogenated organic compounds (including chlorobenzene, -toluene, -naphthalene, -benzyl, and -norbornane derivatives) were indentified and quantified. Based on the qualitative and quantitative data obtained, the sources of these pollutants were identified, and the relative migration of chemicals from the two dumps to the Niagara River was established. The impact on the river is localized to the immediate vicinity of the outfall of the sewer draining the Love Canal neighborhood. Remedial action could be as easy as removing 20 truckloads of contaminated sediment from the river. (Author's abstract)
W85-04718

MACROINVERTEBRATES IN A SEWAGE-POLLUTED AQUIFER,
Ministry of Works and Development, Christchurch (New Zealand). Hydrology Centre.
L. W. Sinton.
Hydrobiologia, Vol. 119, No. 3, p 161-169, December, 1984. 1 Fig, 3 Tab, 26 Ref.

Descriptors: *Macroinvertebrates, *Wastewater pollution, *Water pollution effects, *Aquifers, *Land disposal, *Templeton, *New Zealand, Groundwater pollution, Crustaceans, Turbellarians, Oligochaetes, Amphipods.

The macroinvertebrate fauna in a polluted alluvial gravel aquifer downstream of a sewage irrigation area at Templeton, New Zealand, was surveyed using an existing array of unpumped wells. Three crustacean species - Phreatoicus typicus, Phreatogammarus fragilis and Paracrangonyx compactus - accounted for 98% of the organisms present. The remainder consisted of turbellarian and oligochaete worms and two further crustacean taxa - Paraleptamphopus subterraneus and a new species of the genus Paracrangonyx. Smaller invertebrates found included juveniles of the macroinvertebrate Crustacea and a new amphipod genus and species. Mean population density and dry weight biomass estimates for the three principal crustacean species in the groundwater underlying the disposal area were, respectively, 192 sq m and 0.43 g sq m for P. typicus, 55 sq m and 0.16 g sq m for P. fragilis, and 18 sq m and 0.04 g sq m for P. compactus. Approximately 10% of the crustacean specimens tested contained coliform bacteria and had apparently been feeding on sewage-derived material. The organisms tended to be more abundant in the more polluted wells by incidents of heavy contamination caused high mortality rates. Some calculations using energetics data from surface water studies suggested that the standing crop of aquifer macroinvertebrates could play a significant role in the consumption of sewage-derived organic matter reaching the phreatic zone beneath the Templeton site. (Author's abstract)
W85-04720

METHODS OF PH CALIBRATION OF SEDIMENTARY DIATOM REMAINS FOR RECONSTRUCTING HISTORY OF PH IN LAKES,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
R. B. Davis, and D. S. Anderson.
Hydrobiologia, Vol. 120, No. 1, p 69-87, January, 1985. 9 Fig, 5 Tab, 50 Ref.

Descriptors: *Diatoms, *Lake Sediments, *Hydrogen ion concentration, *Paleolimnology, *Bioindicators, *Norway, *Maine, *Vermont, *New Hampshire, Acid lakes, Sediments, Species composition, Water pollution effects.

The pH history of lakes can be inferred from diatom remains in dated sediment cores. To derive transfer functions for pH inference in acidic lakes, we counted diatoms in surface-sediment from 31 soft-water lakes in n. New England (NE) and 36 in Norway (N), covering pH 4.4-7.1. Cluster analysis of each data set indicates that pH 6 is an upper limit for a group of similar diatom assemblages. For each set multiple linear regressions were developed to relate three versions of the diatom data to pH of surface-waters: (1) relative frequencies of selected diatom taxa, (2) the first principal component (1PC) of these frequencies, and (3) the frequencies of Hustedt pH groups. Also, simple linear regressions were developed for two versions: (1) Index B and (2) Index Alpha, both based on pH groups. Regressions were run separately for lakes with pH < or = 6; these are most relevant for pH inference in acidic lakes. The best regressions (N: taxa and 1PC taxa) have r squared 0.69-0.91 and S sub e 0.24-0.31 pH units, the worst (NE: log alpha) have r squared 0.27-0.57 and S sub e 0.51. In all cases, errors for NE are greater than N, partly due to greater diversity of NE lakes. Regressions based on pH groups (directly and by indices) have smaller r squared and larger S sub e than those based on taxa and 1PC taxa. The Index Alpha is least useful because its requirement for alkaline diatom units is unsatisfied at many acidic lakes. Regressions based

on taxa may give erratic pH inferences due to sensitivity to unusual frequencies for individual taxa; this effect is reduced by using 1PC taxa. Four regressions based on pH < or = 6 lakes were used for inferring pH in a Pb-210 dated core from Nedre Malmesvatn, N (now pH 4.6). There is good agreement among three of the four (not for the regression based directly on taxa) that there has been a decrease of ca. 0.6 pH units starting in the late 1800's. (Author's abstract)
W85-04725

IRRIGATION OF SWINE LAGOON EFFLUENT ONTO PINE AND HARDWOOD FORESTS,
South Carolina Agricultural Experiment Station, Clemson.
For primary bibliographic entry see Field 5D.
W85-04741

ACID RAIN: DOUSING COMMUNITY RESOURCES,
For primary bibliographic entry see Field 5F.
W85-04750

5-ALPHA(H)-CHOLESTAN-3-ALPHA-OL IN SEDIMENTS: CHARACTERIZATION AND GEOCHEMICAL SIGNIFICANCE,
Geneva Univ. (Switzerland). Mass Spectrometry Center.
For primary bibliographic entry see Field 2K.
W85-04759

REVIEW OF THE FOOD AND DRUG ADMINISTRATION RISK ANALYSIS FOR POLYCHLORINATED BIPHENYLS IN FISH,
Everest Consulting Associates, Inc., Princeton Junction, NJ.
L. D. Maxim, and L. Harrington.
Regulatory Toxicology and Pharmacology, Vol. 4, No. 2, p 192-219, June, 1984. 4 Fig, 12 Tab, 35 Ref.

Descriptors: *Polychlorinated biphenyls, *Public health, *Fish, *Water pollution effects, *Risk factors, Regulations, Foods, Carcinogens.

The analysis made by the FDA of the risk to humans from consuming fish contaminated with polychlorinated biphenyls (PCBs) is reviewed. The methods used to arrive at the conclusions employed high dose experiments on animals and extrapolated the observed rates of certain types of cancer at these elevated doses to the low doses found in human diets. These extrapolations were then used to define a recommended tolerance level of 5 ppm, and proposed reduction to 2 ppm, for fish sold in interstate commerce. When confronted with methodological choices, the FDA consistently selected worst case or conservative assumptions over other alternatives of at least equal plausibility. This philosophy of choice was explicitly acknowledged by the FDA. What was omitted from the FDA analysis was the possible degree of overstatement of these risks. The results of replicate risk computation using alternative assumptions to examine the possible magnitude of overstatement of health risk are presented. This overstatement could easily account for a discrepancy of several orders of magnitude between actual and calculated risks. Taken together the points which are made challenge the analytical foundation underlying an FDA proposal to reduce the tolerance level from 5 to 2 ppm and, in addition, lend necessary perspective to the debate on the health risks of eating PCB-contaminated fish. (Baker-IVI)
W85-04775

ECOEPIDEMIOLOGY - A CASUISTIC DISCIPLINE DESCRIBING ECOLOGICAL DISTURBANCES AND DAMAGES IN RELATION TO THEIR SPECIFIC CAUSES: EXEMPLIFIED BY CHLORINATED PHENOLS AND CHLOROPHENOXY ACIDS,
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
F. Bro-Rasmussen, and H. Lokke.
Regulatory Toxicology and Pharmacology, Vol. 4, No. 4, p 391-399, December, 1984. 3 Fig, 2 Tab, 10 Ref.

Descriptors: *Water pollution effects, *Ecoepidemiology, *Chlorophenoxy acids, *Chlorinated phenols, *Koge Bay, *Denmark, Phenols, Industrial wastes, Fish, Aquatic plants, Organic compounds, Saw mills, Industrial wastewater.

Ecoepidemiology is a new concept created in analogy to human epidemiology and aimed at the study of ecotoxicological effects at the levels of ecosystems, biological communities, and populations in relation to causative environmental exposures, mostly by chemicals. Ecoepidemiology is described by presenting an example of unintentional dissipation and possible discharges of chlorophenols and phenoxy acids into the terrestrial environment and, as a more specific case, a marine, aquatic area, the Koge Bay, immediately to the south of Copenhagen, Denmark. The Koge bay Coastal area functions as a recipient for heavy urban sewage as well as discharges for several industries along the coastline and runoff from a rich agricultural area. Koge Bay is a coastal system with a reasonably high capacity as a recipient for emissions, outflows, and discharges due to the lively exchange of water which is characteristic for that region. Fish in the Bay have shown the earliest signs of specific contamination. The macrovegetation is severely disturbed in the Bay. Overall productivity for the benthic communities is below average for Danish coastal areas, although not significantly different from the Baltic Sea baseline level. Fish populations may suffer primarily from the sawmill discharges, which are characterized by a high BOD load, by the contribution of various phenols as well as by a considerable amount of sulfur dioxide deriving from the bleaching processes in the sawmill. Both the flora and fauna examples indicate that biochemical as well as physiological alterations within an ecosystem should be investigated. (Baker-IVI)
W85-04777

MAJOR ION CHEMISTRY AND SENSITIVITY TO ACID PRECIPITATION OF SIERRA NEVADA LAKES,
California Univ., Santa Barbara. Dept. of Biological Sciences.
J. M. Melack, J. L. Stoddard, and C. A. Ochs.
Water Resources Research, Vol. 21, No. 1, p 27-32, January, 1985. 1 Fig, 3 Tab, 30 Ref. OWRT project A-080-CAL and Water Resources Center project UCAL-WRC-W-590.

Descriptors: *Lakes, *Chemical properties, *Sierra Nevada, *Acid rain, *Ions, Alpine regions, Subalpine regions, Sulfate, Calcium, Bicarbonate, Alkalinity, Drainage basins, Geology.

Measurements were made of all major anions and cations for a set of high altitude lakes representative of the geological and ecological diversity of the Sierra Nevada. Watershed characteristics were examined as potential determinants of the major ion chemistry with emphasis on alkalinity. The lakes sampled span the length of the Sierra Nevada and occur on the eastern and western sides of the crest. Eighty percent are in the alpine and subalpine zones and the remainder lie in the montane zone. The lakes range in surface area from 0.3 ha to 578 ha; watersheds range in area from 14 ha to 8539 ha. The ratios of drainage area to lake area range from 2.2 to 273. The waters of the Sierra Nevada lakes were extremely dilute and very weakly buffered. The low alkalinity of the Sierran waters is especially striking. Seventy percent of the lakes sampled have summer alkalinities below 90 micro-eq/liter. The few lakes with alkalinities above 210 micro-eq/l are either located below 3000 m above sea level or in basins with calcareous rocks. Almost all Sierran lakes would be classified as highly sensitive to acid precipitation. The major cation in the lakes is calcium, and bicarbonate is the major anion in most. The role of drainage basin characteristics on the chemical composition of Sierran lakes was investigated with the result that a positive relationship was noted between sulfate, calcium, or alkalinity and volcanic or calcareous rocks. As of 1981 most of the subalpine and alpine lakes of the Sierra Nevada are very dilute and weakly buffered with a predominance of calcium and bicarbonate. The summer pH's range from circa 6 to 8. The lakes do not appear to show signs of acidification but are extremely sensitive to slight increases in the acidity of atmospheric precipitation. (Baker-IVI)
W85-04789

MODELING THE EFFECTS OF ACID DEPOSITION: ASSESSMENT OF A LUMPED PARAMETER MODEL OF SOIL WATER AND STREAMWATER CHEMISTRY,
Virginia Univ., Charlottesville. Dept. of Environmental Sciences.
B. J. Cosby, G. M. Hornberger, and J. N. Galloway.
Water Resources Research, Vol. 21, No. 1, p 51-63, January, 1985. 7 Fig, 7 Tab, 46 Ref.

Descriptors: *Acid deposition, *Soil water, *Chemical properties, *Model studies, *Streams, Soil cation exchange, Aluminum hydroxide, Carbon dioxide, Soil chemical properties, Lumped parameter models, White Oak Run, Virginia.

Quantitative predictions of the effects of acid deposition on terrestrial and aquatic systems require physically based, process-oriented models of catchment soil water and streamwater chemistry. A desirable characteristic of such models is that they include terms to describe the important phenomena controlling a system's chemical response to acidic deposition, yet be restricted in complexity so that they can be implemented on diverse systems with a minimum of a priori data. An assessment is presented of a conceptual model of soil water and streamwater chemistry based on soil cation exchange, dissolution of aluminum hydroxide, and solution of carbon dioxide, all processes that occur in catchment soils and that have rapid equilibration times. The model is constructed using an 'average' or lumped representation of these spatially distributed catchment processes. The adequacy of the model is assessed by applying it to 3 years of soil water and streamwater chemistry data from White Oak Run, Virginia, a second-order stream in the Shenandoah National Park. Soil properties predicted by the model are in good agreement with presently available measurements of those soil properties. The success of the model suggests that lumped representations of complex and spatially distributed chemical reactions in soils can efficiently describe the gross chemical behavior of whole catchments (e.g., pH, alkalinity, and major ionic concentrations in surface waters). Further assessment of the adequacy of this conceptual approach will require more detailed empirical knowledge of the soil processes being modeled, particularly soil cation exchange and the variability of soil CO2 partial pressures. (Author's abstract)
W85-04792

SURVIVAL OF EGGS AND ALEVINS OF ATLANTIC SALMON (SALMO SALAR) IN RELATION TO THE CHEMISTRY OF INTERSTITIAL WATER IN REDDS IN SOME ACIDIC STREAMS OF ATLANTIC CANADA,
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
G. L. Lacroix.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 292-299, February, 1985. 6 Fig, 2 Tab, 39 Ref.

Descriptors: *Salmon, *Immature growth stages, *Fish eggs, *Interstitial water, *Acid streams, Hydrogen ion concentration, Dissolved oxygen, Redds, Water pollution effects, Hatching.

Eggs of Atlantic salmon (Salmo salar) were incubated in spawning areas of five streams of mean pH 4.6-6.5. Hatching success (36.6-88.7%) for eggs planted after fertilization in the natural substrate of four acidic streams was highly correlated with the pH (4.5-5.0) of interstitial water, and the LL50 was about pH 4.7. Dissolved oxygen concentrations (> 6.0 mg/L) in the interstitial water in these streams were probably not limiting to embryos before hatching. In a near-neutral stream (pH 6.5), the comparatively lower hatching success (5.6-77.0%) was significantly correlated with minimum dis-

solved oxygen concentration (1.4-9.2 mg/L) in the interstitial water, and the mean survival of embryos was very low (16.2%) at oxygen concentrations < 6.0 mg/L. Conditions in the substrate where eggs were incubated until hatching were representative of those in natural salmon redds. In one of the acidic streams (pH 4.8), dissolved oxygen concentrations in the interstitial water were low (2.0-7.6 mg/L) after the hatch, and the emergence of salmon fry from natural redds was minimal, which indicated a low survival of alevins. Estimates of critical pH levels for salmon embryos differ between the laboratory and field approach and are probably site specific because survival in acid waters is determined by acidity, related chemical factors, and changes in water quality within the redd environment. (Author's abstract)
W85-04845

MINERAL DISTRIBUTION AND ECOLOGICAL ROLE OF A RECENTLY FORMED HALOPHYTE COMMUNITY IN THE GUANABARA BAY RIO DE JANEIRO,
Universidade Federal do Rio de Janeiro (Brazil). Inst. de Biofisica.
L. D. De Lacerda, W. C. Pfeiffer, and M. Fiszman.
Tropical Ecology, Vol. 24, No. 2, p 162-169, 1983. 1 Fig, 4 Tab, 23 Ref.

Descriptors: *Halophytes, *Plant communities, *Chromium, *Minerals, *Guananbara Bay, *Brazil, Water pollution effects, Estuarine environment, Sodium, Potassium, Calcium, Magnesium, Wetlands, Detritus.

The intensive use of the southwestern coastal areas of Guanabara Bay has caused changes in the natural arboreal strata, mainly mangrove, leaving behind some herbaceous plants resistant to the new situation. One of the most important of the newly formed communities is that of the two perennial halophytes Sesuvium portulacastrum and Phyloxeros vermicularis. The distribution of the nutrients Na, K, Ca and Mg, and the pollutant Cr was studied in a community composed of S. portulacastrum and P. vermicularis in a estuarine area of the bay. All the elements were differentially distributed between the two soil depths sampled, concentrations being higher in the surface layer (0-5.0 cm) than in the deeper one (20.0-30.0 cm). The soil organic matter is mainly responsible for the retention of all elements, except Cr, and directly controls their distribution in the soil. Litter, being the greatest nutrient reservoir, represents the major nutrient cycling component. Both species present a high degree of resistance to Cr pollution. Comparison of mineral concentrations in rain water and runoff indicates that the studied community is a continuous source of Na, K, Ca and Mg to the estuarine food chains. Chromium is retained, mainly complexed with litter, and cannot reach the estuarine ecosystem to cause any abrupt contamination. (Moore-IVI)
W85-04851

PRIMARY PRODUCTION AND DIURANAL VARIATION IN A TROPICAL FISH POND,
Government Post Graduate Coll., Chhindwara (India).
K. S. Unni.
Tropical Ecology, Vol. 24, No. 2, p 170-179, 1983. 4 Fig, 1 Tab, 17 Ref.

Descriptors: *Primary productivity, *Diurnal variation, *Fish ponds, Water pollution effects, Laundry, Wastewater pollution, Thermal stratification, Dissolved oxygen, Alkalinity, Eutrophication.

The gross primary production of a fish pond receiving sewage and being used for domestic laundry, amounted to 36.01 g O2/sq m/day by the diurnal integrated curve method and 45.2 g O2/sq m/day by the light and dark bottle method. Production was negative at 1 m depth due to 52-140% consumption of oxygen for respiration. A distinct thermal stratificaton was found during the day. Electrical conductivity varied both vertically and horizontally (434-515 micro-mho/cm). A well marked inverse relationship between dissolved oxygen and free CO2 and between phenolphthalein and methyl orange alkalinities were recorded. Closteriopsis, a desmid, was in bloom ranging between 21-176 million cells/L. Closteriopsis, Anabaena and Anabaenopsis showed distinct diurnal movements. Cyclops, Brachionus, Keretella, and polyarthra also exhibited nocturnal movement to the surface. (Author's abstract)
W85-04852

PERIPHYTON COMMUNITY CHANGES ALONG A HEAVY METALS GRADIENT IN A LONG NARROW LAKE,
Victoria Univ. (British Columbia). Dept. of Biology.
A. Austin, and J. Deniseger.
Environmental and Experimental Botany, Vol. 25, No. 1, p 41-52, February, 1985. 3 Fig, 4 Tab, 44 Ref.

Descriptors: *Heavy metals, *Periphyton, *Water pollution effects, *Mine wastes, *Buttle Lake, *Upper Campbell Lake, *British Columbia, Species diversity, Population dynamics, Zinc, Copper, Cadmium.

A lead-zinc-copper mine on Vancouver Island, British Columbia has been a source since 1966 of heavy metal input into a long, narrow oligotrophic lake, Buttle Lake, subject to little previous perturbation. The lake is located in a heavily glaciated valley with steep rock walls and a broad, flat bottom. The lake has an estimated retention time of 1.03 years, an average depth of 45 m, an average width of 1 km, and overall length of 30 km. Upper Campbell lake was also sampled. It is shallower with a mean depth of 22 m, overall length of 17.5 km, and a water retention time of 0.27 years. Levels of nitrates, nitrites, ammonia, orthophosphate, total phosphorus and silica varied little throughout the lake system and seasonal fluctuations were small. Concentrations of heavy metals have risen since inception of the mine. Levels decrease as a fucntion of distance from the south basin of Buttle Lake. Copper, zinc and cadmium frequently exceed Environment Canada criteria for the protection of freshwater aquatic life in soft water. The periphyton community at all five sampling stations was dominated by Navicula cryptocephala. (Baker-IVI)
W85-04860

EFFECTS OF DECHLORINATED SEAWATER ON FISH BEHAVIOR,
Occidental Coll., Los Angeles, CA. Dept. of Biology.
For primary bibliographic entry see Field 5D.
W85-04862

PCB RESISTANCE WITHIN PHYTOPLANKTON POPULATIONS IN POLLUTED AND UNPOLLUTED MARINE ENVIRONMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
E. M. Cosper, C. F. Wurster, and R. G. Rowland.
Marine Environmental Research, Vol. 12, No. 3, p 209-223, 1984. 2 Fig, 1 Tab, 60 Ref.

Descriptors: *Polychlorinated biphenyls, *Phytoplankton, *Water pollution effects, Sandy Hook, New Jersey, Montauk, New York, Diatoms, Marine environment, Photo-adaption.

A comparison between clones of two species of diatoms, Asterionella japonica and Ditylum brightwellii, isolated from Sandy Hook, New Jersey (polluted site) and Montauk, New York (unpolluted site) indicated that some of the clones from Sandy Hook were more resistant to polychlorinated biphenyls (PCB). A. japonica was less sensitive to PCB than D. brightwellii since seven clones of A. japonica from both sites were tolerant of 25 micro-g/liter PCB whereas no clones from either site of D. brightwellii showed such resistance. Growth under high light intensity increased the sensitivity to PCB in all clones except one super-resistant clone from Sandy Hook which was not affected even by additions of 50 micro-g/liter to the growth medium. This interactive effect of light on PCB sensitivity may relate to the photoadaptive characteristics of each clone. (Author's abstract)
W85-04864

TOXICITY OF EFFLUENTS FROM A TIO2 PLANT TO THE HARPACTICOID COPEPOD NITOCRA SPINIPES BOECK,
Uppsala Univ. (Sweden). Inst. of Zoophysiology.
K.-J. Lehtinen, B.-E. Bengtsson, and B. Bergstrom.
Marine Environmental Research, Vol. 12, No. 4, p 273-283, 1984. 1 Fig, 2 Tab, 20 Ref.

Descriptors: *Toxicity, *Titanium dioxide, *Copepods, *Industrial wastes, Water pollution effects, Reproduction, Metals, Precipitates, Brackish water, Benthos.

The effluents from industries producing titanium dioxide were used to demonstrate how environmental factors such as temperature modify the toxicity and behavior of metals. The undiluted TiO2 industrial wastewater is characterized by an extreme acidity, high concentrations of iron and titanium, and low concentrations of other heavy metals. Tests with the harpacticoid copepod, Nitocra spinipes, were performed in brackish water (7 0/00), at 4 C, 7 C, and 21 C. Temperature was found to influence the acute toxicity of the waste water. LC50 values for N. spinipes were 0.087% (4 C), 0.105% (7 C) and 0.12% (21 C) of undiluted wastewater. At room temperature the animal's fecundity was affected at dilutions between 0.0003% and 0.001% and between 0.03% and 0.3%. An acute toxicity test with the dried solid metal fraction resuspended in clean brackish water had an acute LC50 value of 7.6% of undiluted wastewater. The acute toxicity of the effluent increases with decreasing temperature, but the fecundity test demonstrate a complex toxicity pattern. At extremely high dilutions, where no precipitate occurs, the production of offspring was affected. This effect disappeared at higher concentrations where precipitate began to occur, but at higher concentrations with more precipitate, the fecundity was again drastically affected. This points to a strong toxic or mechanical effect of the precipitate itself, and the result from the test with dried precipitate confirms this observation. In the field, this fraction seems to be capable of damaging benthic biota over large areas which receive precipitate from the titanium dioxide industry. (Moore-IVI)
W85-04866

EFFECTS OF MERCURY ON THE PROSOBRANCH MOLLUSC CREPIDULA FORNICATA: ACUTE LETHAL TOXICITY AND EFFECTS ON GROWTH AND REPRODUCTION OF CHRONIC EXPOSURE,
Ministry of Agriculture, Fisheries and Food, Burnham on Crouch (England). Fisheries Lab.
J. E. Thain.
Marine Environmental Research, Vol. 12, No. 4, p 285-309, 1984. 8 Fig, 7 Tab, 22 Ref.

Descriptors: *Toxicity, *Mercury, *Limpets, *Growth, *Reproduction, Heavy metals, Larvae, Spawning, Water pollution effects, Marine environment.

Exposure to a mercury-equilibrated algal suspension containing 0.25, 0.42 and 1 micro-g Hg/liter as mercuric chloride in solution reduced the growth and condition of pairs of adults of the slipper limpet Crepidula fornicata in a 16-week period. Reproduction rates and larval survival to settlement were also reduced over the first three spawning when the exposed pairs reached sexual maturity. The adult and larval 96-h LC50s were 330 and 60 micro-g Hg/liter, respectively, as mercuric chloride in solution, indicating that a 'safety factor' of 0.1 needs to be applied to adult data to protect the most sensitive stage in the life cycle. However, the chronic exposure of the maturing adults showed that levels of inorganic mercury below the 'safe' concentration derived from the adult 96 h LC50 affected growth and reproductive success. (Author's abstract)
W85-04867

EFFECT OF EFFLUENT HIGH IN CHROMIUM ON MARINE SEDIMENT AEROBIC HETEROTROPHIC BACTERIA,
Otago Univ., Dunedin (New Zealand). Dept. of Microbiology.
J. Aislabie, and M. W. Loutit.
Marine Environmental Research, Vol. 13, No. 1, p 69-79, 1984. 4 Fig, 2 Tab, 30 Ref.

Descriptors: *Aerobic bacteria, *Marine sediments, *Chromium, *Sawyers Bay, *New Zealand, Tannery wastes, Industrial wastes, Water pollution effects, Effluents.

Analysis of the types and frequency of occurrence of the aerobic heterotrophic bacteria from a sediment receiving tannery effluent (Sawyers Bay, New Zealand) indicated that the populations differed significantly from that of a sediment which did not receive the effluent. There was also a seasonal variation in the populations. Gram positive isolates made up from 32 to 92% of the population, depending on the sampling time. The attempt to assess whether the presence of Cr in the polluted sediment had selected isolates tolerant to Cr gave interesting results. If Cr(III) (0.1 micromol/ml Cr) was incorporated into the isolating media a larger number of organisms could be isolated from Sawyers Bay sediment than if no Cr was used. This effect was not seen for organisms isolated from the control site, the Leith Mouth. Why this stimulation should occur is not known. When Cr(VI) was added, the number of colonies on the isolating medium was less than on the plates containing no Cr. The tolerance of certain organisms to quite high concentrations of Cr(VI) is evident. In view of the very high concentration of Cr in the Sawyers Bay sediment, 20.38 to 71.15 micromol/g, it is expected that bacteria surviving in that environment have a tolerance beyond 0.1 micromol/ml Cr (III) in Plate Count Agar in an estuarine salts solution. (Baker-IVI)
W85-04869

SIMULTANEOUS EXPOSURE OF ENGLISH SOLE (PAROPHRYS VETULUS) TO SEDIMENT-ASSOCIATED XENOBIOTICS: PART 1 - UPTAKE AND DISPOSITION OF 14C-POLYCHLORINATED BIPHENYLS AND 3H-BENZO(A)PYRENE,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
J. E. Stein, T. Hom, and U. Varanasi.
Marine Environmental Research, Vol. 13, No. 2, p 97-119, 1984. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Water pollution effects, *Fish, *Polychlorinated biphenyls, *Benzo(a)pyrene, Radioactive tracers, Sediment contamination, Pyrenes, Organic compounds, Sole.

English sole were exposed to environmentally realistic levels of sediment-associated tritiated benzo(a)pyrene (3 micro-g BaP/g sediment) and C-14 labeled Aroclor (1 micro-g PCBs/g) separately and together for up to 10 days. The concentrations of BaP and its metabolites in tissues reached steady-state by the first day of exposure, whereas PCBs did not approach steady-state concentrations until the tenth day of exposure. Thus, the net accumulation of BaP and its metabolites by sole was significantly less than the net accumulation of PCB and its metabolites. Although the levels of BaP and its metabolites in English sole sampled from BaP-contaminated areas will probably be low, their presence would indicate that BaP is being continually absorbed and metabolized by these fish to potentially carcinogenic and mutagenic compounds. In addition to differences in the extent of accumulation of BaP and PCN-derived radioisotopes by English sole, the tissues and fluid distribution of these two xenobiotics was dissimilar. The rank of concentrations of PCB-derived radioactivity in tissues and bile was: bile = liver > brain > kidney = gill > skin = blood = muscle and for BaP-derived radioactivity the order was: bile > liver > gill > kidney > skin = blood > muscle > brain. Hydrolysis of bile from PCB/BaP-exposed sole with beta-glucuronidase/arylsulfatase released 35% of the BaP-derived radioactivity and 32% of the PCB-derived radioactivity as primary metabolites. (Baker-IVI)
W85-04870

SUBLETHAL EFFECTS OF OILED SEDIMENT ON THE SAND WORM, NEREIS (NEANTHES) VIRENS: INDUCED CHANGES IN BURROWING AND EMERGENCE,
Oregon State Univ., Newport. Marine Science Center.
B. L. Olla, A. J. Bejda, A. L. Studholme, and W. H. Pearson.
Marine Environmental Research, Vol. 13, p 121-139, 1984. 3 Fig, 3 Tab, 53 Ref.

Descriptors: *Sediments, *Polychaetes, *Water pollution effects, *Behavior, *Oil pollution, Industrial wastes, Oil spills, Toxicity.

A variety of intertidal invertebrates, including polychaetes, exposed to oil under standard toxicity tests have been shown to be relatively tolerant. While oil may not often be acutely lethal, the animals may be affected in other ways. The burrowing and emergence behavior of sand worms in sediment contaminated with sublethal concentrations of Prudhoe Bay crude oil ranging from 74 to 5222 ppm was studied in the laboratory. Nereis virens appeared to be relatively tolerant to oil with less than 40% mortality occurring after 96 hours exposure to concentrations as high as 5222 ppm. Even relatively low concentrations of about 74 ppm induced marked changes in behavior, including total or partial emergence from oiled sediment. These results point to the fact that caution should be exercised in using death to predict the consequences of environmental contamination. Changes in behavior are among a number of various measures - for example, physiological or biochemical - which are being used more frequently to assess the sublethal effects of contaminants. The relatively rapid reversal of behavioral debilitation which occurred following removal of the worms from oil, suggested that debilitation was a manifestation of narcotization. (Baker-IVI)
W85-04871

EFFECTS OF ORGANIC POLLUTANTS ON METHANOGENESIS, SULFATE REDUCTION AND CARBON DIOXIDE EVOLUTION IN SALT MARSH SEDIMENTS,
State Univ. of New York at Stony Brook. Marine Sciences Research Center.
R. P. Kiene, and D. G. Capone.
Marine Environmental Research, Vol. 13, p 141-160, 1984. 1 Fig, 4 Tab, 38 Ref. NOAA grant Na-80-RAD 00057, EPA grant R809475011, Hudson River Foundation grant 14/83B/129.

Descriptors: *Methanogenesis, *Sulfate reduction, *Carbon dioxide, *Salt marshes, *Water pollution effects, Organic compounds, Sediment, Anaerobic conditions, Sulfates, Lindane, Endrin, Benzene, Phenanthrene, Arochlor.

Anaerobic salt marsh sediments were amended with a variety of organic pollutants and the effects on methanogenesis, sulfate reduction and carbon dioxide evolution were examined. The levels of pollutants used in the study were high relative to the levels found in many coastal sediments. The addition of several compounds (benzene, phenanthrene, Arochlor 1221, endrin and lindane) to salt marsh sediments resulted in no signifcant effects on any of the activities studied. In most cases where effects were noted at 1000 micro-g/g, effects were not significant at either 100 or 10 microg/g. Compounds such as Arochlor 1254 and Temik, which stimulated methanogenesis but had no effect on sulfate reduction of carbon dioxide production may have been degraded and metabolized by the methanogenic community. Sulfate reduction accounted for 25 to 150 times the carbon flow relative to methanogenesis. It appears that, over the short term, sulfate reduction and methanogenesis are tolerant of relatively high levels of a range of organic pollutants. (Baker-IVI)
W85-04872

TRACE METAL-BINDING PROTEINS IN MARINE MOLLUSCS AND CRUSTACEANS,
National Marine Fisheries Service, Beaufort, NC. Beaufort Lab.
D. W. Engel, and M. Brouwer.
Marine Environmental Research, Vol. 13, No. 3, p 177-194, 1984. 6 Fig, 2 Tab, 23 Ref.

Descriptors: *Trace metals, *Metallothioniens, *Crabs, *Lobsters, *Oysters, Zinc, Copper, Cadmium, Water pollution effects, Metabolism, Detoxification, Marine environment.

Marine organisms inhabiting coastal and estuarine waters can be exposed to elevated levels of trace metals through both biogeochemical processes and pollution. Some marine invertebrates concentrate trace metals in their tissues, and the occurrence of metallothionein has been correlated with elevated levels of trace metals in these organisms. Field and laboratory experiments were designed to examine how oysters, blue crabs and lobsters manage accumulated cadmium, copper and zinc. Metallothioneins were found in all animals examined; concentrations of metallothioneins and the amount of bound trace metals are related to time of exposure. There is variability in the numbers and types of metal-binding proteins within and between species. The laboratory developed metallothionein models for blue crabs and lobsters may be useful in predicting the partitioning of trace metals in animals living in environments polluted with trace metals. Invertebrate metallothioneins can function as detoxifying proteins, but in unstressed animals, these proteins are involved in the metabolism of nutrient metals. The synthesis and degradation of metallothioneins in marine invertebrates may be highly correlated with the growth, development and physiological status, rather than simply being detoxifying proteins. (Moore-IVI)
W85-04873

BENTHIC-PELAGIC COUPLING IN SEWAGE-AFFECTED MARINE ECOSYSTEMS,
Lawrence Livermore National Lab., CA. Environmental Sciences Div.
R. Spies.
Marine Environmental Research, Vol. 13, No. 3, p 195-230, 1984. 1 Fig, 5 Tab, 107 Ref. DOE contract W-7405-ENG-48.

Descriptors: *Marine environment, *Wastewater pollution, *Benthos, *Pelagic life, *California, Habitats, Fish, Shrimp, Polychaetes, Crustaceans, Outfalls, Effluents, Food chains, Chlorinated hydrocarbons, Trophic-step magnification.

Coupling between degraded benthic habitats and populations of epibenthic and pelagic organisms is evident around major sewage outfalls in the Southern California Bight. The distribution of bottom-feeding fishes appears to be affected, but sampling has not been intensive enough to rigorously define patterns for more than a few species. Some evidence suggests that changes in fish abundance may be related to changes in the distribution and abundance of benthic prey; those species (e.g. Dover sole) that can adapt their diets to take advantage of dense populations of opportunistic polychaetes may be found in large numbers around outfalls. Some benthic crustacean feeders are at a disadvantage. Sewage effluent is an allochthonous source of organic matter to the food web and Dover sole and ridgeback shrimp both show shifts in stable isotope ratios consistent with the thesis that sewage-derived organic matter in sediments is trophically transferred to epibenthic organisms. Constructing a carbon budget based on the delta C-13 shifts in these species from an area of a major outfall relative to a distant control station suggests that there is an in situ source of isotopically very light carbon in outfall sediments, perhaps from CO2 fixation by chemoautotrophs and biological methane oxidation. Benthic-pelagic coupling is also evident in the accumulation of chlorinated hydrocarbons by fish and other organisms: At the two major Los Angeles area outfalls log-transformed liver-to-sediment concentration ratios of chlorinated benzenes, which are accumulated to moderate levels in fish, show a linear relationship to the log of Kow (the octanol-to-water partioning coefficient) of these compounds. Chlorinated hydrocarbons with greater lipid solubility, e.g. PCB and p,p-DDE, are concentrated to very high levels.

Studies of food webs using Cs/K as a measure of trophic level suggest that trophic-step magnification is concentrating these compounds in higher trophic levels. (Author's abstract)
W85-04874

EXPERIMENTAL MARINE ECOSYSTEM RESPONSE TO CRUDE OIL AND COREXIT 9527: PART 2 - BIOLOGICAL EFFECTS,
British Columbia Univ., Vancouver. Dept. of Oceanography.
T. R. Parsons, P. J. Harrison, J. C. Acreman, H. M. Dovey, and P. A. Thompson.
Marine Environmental Research, Vol. 13, No. 4, p 265-275, 1984. 2 Fig, 23 Ref.

Descriptors: *Marine environment, *Water pollution effects, *Oil spills, *Dispersants, Cleanup operations, Oil pollution, Food chains, Primary productivity, Hydrocarbons, Phytoplankton, Zooplankton.

Three experimental ecosystems were employed to test the effect of the dispersant Corexit 9527, with and without Prudhoe Bay crude oil, on the ecology of a temperate pelagic ecosystem. Corexit 9527, by itself, at an initial concentration of about 2 ppm within the 2-4 m layer did not affect the ecology of a planktonic food chain containing primary, secondary and tertiary producers. There is some evidence, however, that the Corexit was metabolized by the bacteria which were consistently more numerous and had a higher metabolic activity than in the control. The concentration of Corexit 9527 at about 1 ppm was clearly sufficient to influence the heterotrophic production of the water column. The effect of crude oil mixed with Corexit 9527 was quite different from Corexit 9527 alone. Primary productivity was severely depressed up to the eighth day of the experiment and then slowly recovered after day 8 to give rise to largely microflagellates ecology instead of centric diatoms. It appears that the dispersed crude oil in these experiments behaved similarly to other petroleum hydrocarbons with respect to phytoplankton and bacterial communities but that the dispersant/crude oil mixture may have been more toxic towards the zooplankton community. Corexit 9527 should not be added to spilled oil during spring bloom conditions but at other times the use of this dispersant may have some beneficial effect, especially if the safety of bird populations is considered. (Baker-IVI)
W85-04875

VASCULAR RIFFLE FLORA OF APPALACHIAN STREAMS: THE ECOLOGY AND EFFECTS OF ACID MINE DRAINAGE ON JUSTICIA AMERICANA (L.) VAHL,
Corps of Engineers, Pittsburgh, PA. Pittsburgh District.
M. Koryak, and R. J. Reilly.
Proceedings of the Pennsylvania Academy of Science, Vol. 58, No. 1, p 55-60, June, 1984. 2 Fig, 3 Tab, 16 Ref.

Descriptors: *Water pollution effects, *Acid mine drainage, *Mine wastes, Ecological distribution, Aquatic plants, Plant growth, Stream erosion, Channel morphology, Substrate.

Justicia americana is a stout-based colonial plant, abundant in most of the larger, low to moderate gradient streams of the upper Ohio River basin. The distribution of J. americana is related to acid drainage from bituminous coal mining operations in the upper Ohio River drainage basin. Possible fluvial and biological consequences of the colonization or absence of Justicia are considered. Luxuriant growths were noted on gravel bars and riffles of larger, unpolluted streams in the basin. Acid mine drainage severely depresses the growth of the plant, leaving gravel shoals and riffles in the acidic streams either barren or dominated by other emergent species. Particular among these new species is Eleocharis acicularis. The elimination of J. americana from suitable habitat adversely affects channel morphology, substrate composition, general aesthetic quality and aquatic stream life in the region. (Baker-IVI)
W85-04884

ALACHLOR TOXICITY TO A FRESHWATER TELEOST CLARIAS BATRACHUS,
D.A.V. Coll., Muzaffarnager (India). Dept. of Zoology.
K. A. Goel, Kalpana, Sandhya, and V. P. Agrawal.
Current Science, Vol. 53, No. 19, p 1050-1052, October, 1984. 1 Tab, 12 Ref.

Descriptors: *Pesticide toxicity, *Fish, *Alachlor, Toxicity, Herbicides, Water pollution effects.

Alaclor is a herbicide widely used for the weeds of cereals, legumes and cotton. Live fish (Clarias batrachus) were treated with the sublethal concentration of 0.001% alachlor in water at 25 degrees C at pH 6.8 for 15 days. Exposure of C. batrachus to alachlor resulted in a significant increase in the total leukocyte count, MCV, MCH, in the activities of AlPase, AcPase, GOT, GPT and blood urea, and a significant decrease in erythrocyte count, Hb%, MCHC and PCV. The decrease of serum bilirubin and chloresterol after treatment was not significant. The changes which were significant indicate the fish body is under stress on exposure to alachlor. Distorted metabolism resulted from liver dysfunction or from cellular injuries in different tissues. (Baker-IVI)
W85-04885

COMPARATIVE SURVEY OF THE ERPOBDELLA OCTOCULATA (L.) POPULATIONS IN THE AFON CRAFNANT, N. WALES, ABOVE AND BELOW AN INPUT OF ZINC FROM MINE-WASTE,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
M. Willis.
Hydrobiologia, Vol. 120, No. 2, p 107-118, January, 1985. 7 Fig, 2 Tab, 20 Ref.

Descriptors: *Leeches, *Mine wastes, *Zinc, *Water pollution effects, Reproduction, Growth, Bioaccumulation, Heavy metals, Food.

The life-cycle, growth, and reproductive success of a stream-dwelling Erpobdella octoculata (L.) were studied over a 19-month period at two sites, one above and one below an input of zinc pollution from mine-waste. Samples were collected monthly using quadrats. The blotted wet weight of all leeches was measured. An histological technique was employed to determine sexual maturity. Reproductive success was measured by estimating the numbers of cocoons and number of eggs per cocoon at each site. A wet ashing technique, followed by analysis using flame atomic absorption spectrometry, was used to determine the extent of bioaccumulation of zinc. 'Total' zinc and other metals in the waters were similarly analyzed. Differences were found between the populations at the two sites. The life-history of the Erpobdella above the contamination was comparable to that found for other stream-dwelling populations previously studied. Observed differences in densities of leeches between sites in the present and in previous studies by other workers may be due to recorded differences in the abundance of available food. At the polluted site, there was evidence that (a) there was a delay in cocoon deposition and hence hatching of young, (b) the adult leeches produced more misshapened and empty cocoons, (c) no relationship existed between the area of cocoons with eggs and number of eggs present, and (d) the proportion of young to adult leech was smaller at the polluted site. At the polluted site, higher levels of zinc were recorded in the tissues of Erpobdella and there was some evidence for the active intake of zinc by the leech. (Author's abstract)
W85-04886

HEAVY METALS IN THE BOMBAY HARBOUR AREA,
Bhabha Atomic Research Centre, Bombay (India). Health Physics Div.
B. Patel, V. S. Bangera, S. Patel, and M. C. Balani.
Marine Pollution Bulletin, Vol. 16, No. 1, p 22-28, January, 1985. 5 Fig, 8 Tab, 13 Ref.

Descriptors: *Heavy metals, *Bombay harbor, *India, *Water pollution effects, Clams, Mudskippers, Sediments, Anoxic conditions, Industrial wastes, Wastewater pollution, Benthos.

Bombay harbor is one of the major sinks, on the western peninsula of the Indian subcontinent, receiving anthropogenic pollutants including heavy metals, radio-nuclides and hydrocarbons in addition to sewage. To evaluate possible impacts of a few heavy metals on the harbor ecosystem, the distribution patterns of Zn, Mn, Cu, Fe, Co, Ni, Cd, Cr, Pb and Sr in water, sediment and two benthic species, the blood clam Anadara granosa and gobiid mudskipper Boleophthalmus boddaerti were studied over the period 1976-1980. The present levels of the ten elements in biotic and abiotic matrices were found to be far below those that are known to affect adversely the life and quality of benthic communities. Furthermore, the concentrations of these elements in various compartments neither revealed any systematic temporal or spatial fluctuations nor reflected the substantial increase in the total budget over the past 8-12 years. Also these levels were within the range reported in the nearshore and oceanic environs along the west coast. In view of this, the poor growth and high percentage mortality observed in the clam Anadara granosa fished from the Sewri clam bed compared to that of the stock harvested from the Trombay region in the harbor may well be due to anoxic conditions caused by organic pollutants present in the domestic sewage and industrial wastes released in the vicinity of the Sewri clam bed. (Author's abstract)
W85-04892

EMBRYO ABNORMALITIES IN THE PERIWINKLE, LITTORINA 'SAXATILIS', AS INDICATORS OF STRESS IN POLLUTED MARINE ENVIRONMENTS,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 5A.
W85-04893

COMPARATIVE STUDY OF RESPIRATION RATES OF SOME AQUATIC OLIGOCHAETES IN RELATION TO SUBLETHAL STRESS,
Institute of Ocean Sciences, Sidney (British Columbia).
R. O. Brinkhurst, P. M. Chapman, and M. A. Farrell.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 683-699, 1983. 11 Fig, 6 Tab, 33 Ref. Canadian DDS contract 07SB.FP 833-9-0965.

Descriptors: *Oligochaetes, *Respiration rate, *Stress, Water pollution effects, Hydrogen ion concentration, Salinity, Water temperature, Cadmium, Mercury, Sodium pentachlorophenol, Pollution tolerance.

Aquatic oligochaete species selected on the basis of pollution tolerance or intolerance as determined from field studies were used to determine respiration rates under standard conditions, after exposure to sublethal levels of environmental variables (pH, salinity, temperature) or toxicants (Cd, Hg, sodium pentachlorophenol) alone or in pairs. Respiration rates, critical oxygen levels and degree of regulation were not correlated with field-determined tolerance to organic pollution. Stress factors caused increased or lowered respiration rate, loss of regulation (partial or total) and sometimes shifts in critical oxygen level. Regulation was improved in the face of some stresses. Combined stresses produced additional changes in respiration rates and regulation. These responses were complex, which makes them useful indicators of specific stress factors but also indicate complex mechanisms behind the observed changes. (Author's abstract)
W85-04905

COMPARISON OF PLANKTON-WATER CHEMISTRY RELATIONSHIPS IN THREE ACID STRESSED LAKES IN NOVA SCOTIA, CANADA,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.

For primary bibliographic entry see Field 2H.
W85-04911

INFLUENCE OF WATER HYACINTH COVER ON THE PHYSICO-CHEMICAL CHARACTERISTICS OF WATER AND PHYTOPLANKTON COMPOSITION IN A RESERVOIR NEAR JAIPUR (INDIA),
Rajasthan Univ., Jaipur (India). Dept. of Botany.
B. Gopal, R. K. Trivedy, and P. K. Goel.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 859-865, 1984. 2 Tab, 17 Ref.

Descriptors: *Water hyacinth, *Phytoplankton, *Physicochemical properties, *India, Reservoirs, Water pollution, Eutrophication, Water temperature, Hydrogen ion concentration, Dissolved oxygen, Nutrients, Cyanophyta, Chlorophyta.

Water hyacinth (Eichhornia crassipes (Mart.) Solms.) invaded a eutrophic reservoir receiving domestic sewage near Jaipur (India) during 1975 and gradually developed a complete thick cover over the whole water body during Sept.-Oct. 1978. The physico-chemical characteristics of the water and the phytoplankton composition were studies during Sept. 1977-Sept. 1979 by fortnightly sampling. The changes observed during the second year of study are ascribed to the water hyacinth cover. The important changes were: lowering of water temperature, pH, dissolved oxygen content and nitrate nitrogen, and increase in total alkalinity, free carbon dioxide, chemical oxygen demand, ammonia nitrogen, sulfides, calcium, magnesium and phosphate phosphorus. The changes in the phytoplankton were both qualitative and quantitative. The green algae, particularly the species of Ankistrodesmus, Chlorella, Crucigenia and Selenastrum, increased considerably and replaced the blue-green algae, of which Oscillatoria and Microcystis disappeared totally. The densities of several other taxa changed significantly. (Author's abstract)
W85-04913

COLORADO COOPERATIVE FISHERY RESEARCH UNIT STUDIES OF TWIN LAKES, COLORADO; 1980 REPORT OF FINDINGS,
Colorado Cooperative Fishery Research Unit, Fort Collins.
E. P. Bergersen, and M. Maiolie.
Available from the National Technical Information Service, Springfield, VA 22161. Bureau of Reclamation Report REC-ERC-82-8, December 1981. 59 p, 83 Fig, 2 Tab, 18 Ref, 1 Append. Contract/Grant No. 7-07-83-V0700.

Descriptors: *Lakes, *Ecological effects, *Baseline studies, *Powerplants, *Trout, *Shrimp, *Sedimentation rates, *Limnology, Environmental effects, Vegetation effects, Water level fluctuations, Lake sediments, Population density, Organic matter, Sediment transport, *Colorado, Twin Lakes (Colorado).

Baseline data on the Twin Lakes system was gathered to fill gaps in the present knowledge of the preoperational phase of the Mt. Elbert Pumped-Storage Powerplant, to test monitoring methodologies, and point out monitoring problems that might be encountered during the operational phase of the project. A study on lake currents characterized and documented natural, seasonal patterns in surface and bottom currents in the two-lake system. The study on lake trout spawning habits showed that it is unlikely that lake trout in Twin Lake spawn in water less than 1.5 m deep. The expected daily water level fluctuations 0.7 to 1.1 m should not result in the exposure of lake trout eggs. A photographic method of estimating Mysis shrimp densities eliminates depletion of the population. Shrimp are at least 2.4 times as abundant in Twin Lakes as previously thought, with densities in the vicinity of the powerplant as high as 232 shrimp/sq m. Estimates of sedimentation rates by sediment traps and inflow/outflow suspended sediment sampling differed greatly. The best time to monitor powerplant impacts on sediment movement and deposition appeared to be during the winter months. Potential organic contribution from vegetation inundated by new lake levels was estimated to be over four times the present average annual primary production of the system. A water level control scheme is suggested to minimize the effects of a large organic influx.
W85-04937

CHLOROPHENOLS AND THEIR IMPURITIES IN THE CANADIAN ENVIRONMENT: 1983 SUPPLEMENT,
Environmental Protection Service, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W85-04941

AQUATIC TOXICITY OF 2,6-DICHLOROBENZAMIDE (BAM), A DEGRADATION PRODUCT OF THE HERBICIDE DICHLOBENIL,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands). Lab. for Ecotoxicology.
C. J. Van Leeuwen, and H. Maas.
Environmental Pollution (Series A), Vol. 37, No. 2, p 105-115, 1985. 3 Fig, 5 Tab, 21 Ref.

Descriptors: *Herbicides, *Pesticide toxicity, *Dichlorobenzamide, *Dichlobenil, Guppies, Trout, Daphnia, Algae, Toxicity, Larvae, Aquatic weed control.

Dichlobenil (2,6-dichlorobenzonitrile) is a broad-spectrum herbicide of which the aquatic toxicological properties are well documented compared to the scarcity of data on the toxicity of its main degradation product BAM (2,6-dichlorobenzamide). Therefore toxicity tests with BAM were carried out with several freshwater species. Short term experiments showed that BAM was moderately toxic to guppies Poecilia reticulata, rainbow trout Salmo gairdneri, daphnids Daphnia magna and the algae Chlorella pyrenoidosa and Scenedesmus pannonicus. In long term studies with daphnids concentrations up to 320 mg/l did not significantly alter survival and reproduction. An embryo-larval test with rainbow trout, however, showed a significant reduction of survival and growth as well as a delay of yolk resorption at concentrations equal to or exceeding 18 mg/l. In combination with the data reported in the literature it may be concluded that degradation of dichlobenil into BAM results in a reduction of toxicity and further biodegradability. Normal field applications of this aquatic herbicide are not expected to impose a great risk to aquatic life. (Author's abstract)
W85-04944

ACUTE TOXICITY OF COPPER TO THREE LIFE STAGES OF CHRIONOMUS TENTANS AS AFFECTED BY WATER HARDNESS-ALKALINITY,
Miami Univ., Oxford, OH. Dept. of Zoology.
J. D. Gauss, P. E. Woods, R. W. Winner, and J. H. Skillings.
Environmental Pollution (Series A), Vol. 37, No. 2, p 149-157, 1985. 3 Tab, 21 Ref.

Descriptors: *Toxicity, *Copper, *Midges, Water pollution effects, Water hardness, Alkalinity, Eggs, Larval growth stage.

The relative sensitivites of the eggs, first- and fourth-instar larvae of the midge Chironomus tentans to an acute copper stress as affected by the hardness-alkalinity of the test water were compared. Mean EC50s for first-instar larvae exposed in soft and medium water were not significantly different. First-instar larvae were less sensitive to copper in hard water than in either soft or medium water. Mean EC50s for fourth-instar larvae were not significantly different in medium and hard water but both of these were significantly higher than in soft water. First-instar larvae were significantly more sensitive to copper than were fourth-instar larvae for each water type. Eggs were the most copper resistant life stage tested. If sensitivity to copper is representative of sensitivity to other chemicals, the practice of using fourth instar larvae in toxicity tests may grossly underestimate the sensitivity of the species to toxicants. (Baker-IVI)
W85-04946

5D. Waste Treatment Processes

ADSORPTION AND COMPLEXATION MECHANISMS OF HEAVY METAL UPTAKE IN ACTIVATED SLUDGE,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
P. S. Lawson, R. M. Sterritt, and J. N. Lester.
Journal of Chemical Technology and Biotechnology, Vol. 34B, No. 4, p 253-262, December, 1984. 4 Fig, 5 Tab, 28 Ref.

Descriptors: *Metal removal, *Activated sludge, *Complexation, *Adsorption, Wastewater treatment, Heavy metals, Copper, Cadmium, Manganese, Nickel.

Differences were observed between the uptake of cadmium, copper, manganese and nickel by activated sludge biomass: their removal was studied when a range of metal concentrations was added to resuspended mixed liquor solids in the absence of possibly competitive organic ligands. The predominant mechanism of metal removal was passive uptake with some indication of binding site specificity for copper and possibly manganese. The data obtained were interpreted in the form of adsorption isotherms. The results were used to calculate conditional stability constants (K') of the complexes formed, and the complexation capacity of the biomass for heavy metal uptake. Studies were conducted over a range of sludge ages from 3 to 12 days. Log K' values between 4.6 and 6.7 were found. However, there was no direct relationship between sludge age and K'. EDTA was used to desorb bound metal: this provided a means of differentiating between the surface complexes and unexchangeable metal such as that taken up intracellularly. There was a difference in the adsorption affinity series of the metals when EDTA was present. This indicated that more than one mechanism for metal uptake was operating, and that the relative importance of physical and chemical absorption varied with each metal. (Author's abstract)
W85-04411

PILOT-PLANT EVALUATION OF A DEEP SHAFT LINKED TO CONVENTIONAL AERATION WITHOUT INTER-STAGE SETTLEMENT TO GIVE A FULLY-NITRIFIED EFFLUENT,
Wessex Water Authority, Bristol (England).
M. S. Robinson.
Water Pollution Control, Vol. 83, No. 1, p 58-70, 1984. 6 Fig, 9 Tab, 33 Ref.

Descriptors: *Wastewater treatment, *Nitrification, *Aeration, *Deep shaft treatment, Ammonia, Biochemical oxygen demand, Suspended solids, Nitrogen, Pilot plants.

The deep-shaft method of sewage treatment consists of a vertical aeration lane sunk 60-150 m below ground level. Settled sewage and returned activated sludge are fed into the downcomer section of the shaft and air is introduced into the riser to initiate and maintain circulation and also into the downcomer as process air. In a pilot scale study a deep shaft has successfully been added in series with an existing aeration lane without inter-stage settlement, and the complete system nitrified in the F:M range 0.15-0.24. The minimum sludge age needed to maintain full nitrification was 3-4 days in summer and about 10 days in winter. The best effluent quality from the pilot plant was achieved under conditions of constant design flow after installation of an anoxic zone. Under conditions of full diurnal variation in flow the 95 percentile effluent quality was 13:12:4.5 (SS:BOD:amm.N). A 50% increase in load reduced the 95 percentile effluent quality to 13:17:6.3 and a further increase in load (75%) brought about by increasing the flow (16%) reduced the performance still further to 26:38:13. The deep shaft itself was responsible for all the BOD load removed and 52% of the ammoniacal load. (Baker-IVI)
W85-04452

SEWAGE SLUDGE TREATMENT AND DISPOSAL - THE WAY AHEAD,
For primary bibliographic entry see Field 5E.
W85-04455

RESEARCH RELATED TO WATER POLLUTION CONTROL IN SOUTH AFRICA,
National Inst. for Water Research, Pretoria (South Africa).
G. R. Botha.
Water Pollution Control, Vol. 83, No. 2, p 184-190, 1984. 17 Ref.

Descriptors: *Water pollution control, *South Africa, *Reviews, Wastewater treatment, Pulp and paper industry, Textile industry, Organic compounds, Mining industry, Wastewater disposal, Composting, Aerobic digestion, Reverse osmosis, Public health.

The intensification and growing sophistication of industry and unprecedented urbanization in South Africa have resulted in a tremendous increase in the volume and complexity of sewage and industrial effluents. This, in turn, has created many new problems relating to and including the necessary pollution control measures, treatment methods, increasing salinity of surface waters, health hazards, marine disposal and sludge disposal. A limited overview is presented of some interesting recent and current research projects related to these problems in South Africa. Specific mention is made of the treating of industrial effluents (textile effluents, pulp and paper effluents, other high loading organics, mining industry effluents); the treatment and disposal of sewage sludge (the utilization of digested sewage sludge on land, composting of primary sewage sludge and surplus activated sludge, and autothermic aerobic digestion of sewage sludge); treatment of soluble industrial organic wastes; reclamation of water from secondary sewage effluent by the reverse osmosis process; and health aspects of water supplies. (Baker-IVI)
W85-04456

EFFECTS OF THE RECHARGE ON SEWAGE EFFLUENTS UPON THE QUALITY OF CHALK GROUNDWATER,
For primary bibliographic entry see Field 5C.
W85-04462

TREATMENT OF SEWAGE FOR USE IN MUNICIPAL IRRIGATION IN ABU DHABI, UAE,
Taylor (John) and Sons, London (England).
J. Robinson, and L. J. Smith.
Water Pollution Control, Vol. 83, No. 3, p 387-399, 1984. 3 Fig, 4 Tab.

Descriptors: *Abu Dhabi, *Wastewater treatment, *Wastewater irrigation, Activated sludge process, Water reuse, Water pollution control, Nitrification, Disinfection, Chlorination.

Abu Dhabi City, the major center of population in the United Arab Emirate State of Abu Dhabi saw the establishment of its first sewerage and sewage treatment facilities in 1976. The policy of maximum re-use of treated sewage effluent was established from the outset and has been adhered to throughout subsequent development. Effluent is used solely for municipal irrigation of roundabouts, gardens and central reservations within the city. In each of the three sewage-treatment plants which have successively served the city, treatment has been based on the activated-sludge process with mechanical surface aeration. Per capita sewage flows and strengths are noted with BOD being 60 g/l and SS 55 g/d. Full nitrification resulted in a reduction in alkalinity from 300 mg/l to 46 mg/l and a fall in pH value from 76. to 7.1. After chlorination with a dose of 15 mg/l Cl2, alkalinity reduced further to 27 mg/l and pH value of 6.8. With pre-seeding of the aeration tanks to establish nitrifying organisms the new sewage treatment works produced a fully nitrified effluent witin 10 days of receiving crude sewage flows. High sulfide concentrations in the crude sewage had no adverse effects on biological treatment or the attainment of nitrification. The adverse effects on nitrite formed by partial nitrification on disinfection with chlorine is illustrated. (Baker-IVI)
W85-04464

DECREASING RATE OF BIOCHEMICAL OXIDATION OF SEWAGE,
T. Stones.
Water Pollution Control, Vol. 83, No. 3, p 435-437, 1984. 3 Fig, 3 Tab, 4 Ref.

Descriptors: *Oxidation, *Wastewater treatment, *Biochemical oxygen demand, Wastewater oxidation, Domestic wastes, Dissolved oxygen.

The first stage of biochemical oxidation of sewage that occurs when it is diluted with clean aerated water is a second-order reaction in which the rate of oxidation at any instant is governed jointly by the unsatisfied biochemical oxygen demand (BOD) and the residual dissolved oxygen concentration. Using slightly revised data, calculations were made of the rates of oxidation operative at the intervals during the course of biochemical oxidation when measurements were made of the residual dissolved oxygen concentration. The rates of oxidation occurring at these various intervals expressed as a percentage of the initial rate are presented together with the extent of oxidation from which it is seen that after 2 days the rate of oxidation has already decreased to 37.7% of the initial rate with 47.0% of the first-stage BOD having been satisfied. After 5 days the rate of oxidation had decreased further to 14.8% of the initial rate and the proportion of the oxygen demand that has been satisfied had reached 73.2%. After 10 days the rate of oxidation fell to 4.8% of the initial rate so that the proportion of the oxygen demand that had been met had risen only to 89.3%. After 15 days, when the first stage of oxidation is nearing completion, the rate is then less than 2% of that at the beginning. Thus, when 20% of the first stage BOD has been satisfied the rate of oxidation is 69.5% of the initial rate but only 34.0% thereof when 50% has been satisfied. (Baker-IVI)
W85-04468

IMPORTANCE OF SPECIATION METHODS IN ANALYTICAL CONTROL OF WATER TREATMENT PROCESSES WITH APPLICATION TO FLUORIDE REMOVAL FROM WASTE WATERS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
For primary bibliographic entry see Field 5A.
W85-04485

QUANTITATIVE ESTIMATION IN COD UNITS OF REFRACTORY ORGANIC COMPOUNDS PRODUCED BY ACTIVATED SLUDGE MICROORGANISMS,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Chudoba.
Water Research, Vol. 19, No. 1, p 37-43, 1985. 10 Fig, 1 Tab, 19 Ref.

Descriptors: *Chemical oxygen demand, *Activated sludge, *Microorganisms, *Organic compounds, Culturing techniques, Oxygen demand, Wastewater treatment.

Data on the amounts of refractory organic compounds produced by activated sludge microorganisms under various conditions of cultivation were collected and treated in order to find the main factors influencing their production. The following systems were compared: batch non-proliferating and proliferating, continuous with high and low mean cell residence time and semicontinuous with separate aerobic sludge stabilization. It has been found that there exists a linear relationship between the refractory microbial products and the initial substrate concentration, both expressed in COD units. Both the slope and intercept of the relationship depend on the mean cell residence time or the observed specific growth rate. Depending on the cultivation conditions, the refractory products can amount to 1-10% of the substrate consumed. It has also been found that the amount of refractory compounds, expressed in COD units, released from 1 g of aerobically decomposed biomass varies from 15 to 25 mg/g. (Author's abstract)
W85-04486

BIODEGRADABILITY OF TWO PRIMARY ALCOHOL ETHOXYLATE NONIONIC SURFACTANTS UNDER PRACTICAL CONDITIONS, AND THE TOXICITY OF THE BIODEGRADATION PRODUCTS TO RAINBOW TROUT,
Shell Chemicals U.K. Ltd., London (England).
A. H. Turner, F. S. Abram, V. M. Brown, and H. A. Painter.
Water Research, Vol. 19, No. 1, p 45-51, 1985. 2 Fig, 7 Tab, 23 Ref.

Descriptors: *Biodegradation, *Nonionic surfactants, *Toxicity, *Trout, Wastewater treatment, Detergents, Surfactants.

Biodegradation mechanisms of, and toxicity of the degradation products of, the major types of nonionic surfactants, alchohol ethoxylate and alkylphenol ethoxylate, are not well known. A field trial was performed to measure the biodegradability of two alcohol ethoxylate nonionic surfactants typical of household detergent formulations, 'Dobanol' 45-7 and 'Dobanol' 45-11. The surfactants were dosed to biological filters in a mixture with domestic sewage; influent levels were 10 and 25 mg/l of each surfactant. Within a temperature range of 5-10 C, 96-98% degradation was achieved, showing that even under highly unfavorable conditions these nonionic surfactants remained highly biodegradable. The surfactants had no adverse effects on the filters in terms of the usual sanitary parameters (BOD, COD, TOC and ammoniacal nitrogen). Tests on the effluents indicated no residual acute lethal toxicity to rainbow trout (Salmo gairdneri) within an exposure period of 7 days. Under current conditions of usage and disposal, fatty alcohol ethoxylates do not present an environmental problem. (Collier-IVI)
W85-04487

DETOXIFICATION OF EFFLUENTS IN A MACROPHYTE TREATMENT SYSTEM,
Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irrigation Research.
K. H. Bowmer.
Water Research, Vol. 19, No. 1, p 57-62, 1985. 1 Fig, 3 Tab, 16 Ref.

Descriptors: *Wastewater treatment, *Animal wastes, *Macrophytes, *Aquatic plants, *Cattails, Wheat, Farm wastes, Biological wastewater treatment, Algae, Fatty acids, Toxicity.

Screened, settled, and diluted feces and urine flushed from a hog farm was percolated through the gravel substrate of an aquatic plant filter system in which Typha domingensis Pers. (cattail) was grown hydroponically. The effluent was diluted 2-3 fold to a conductivity of 2500 micro S/cm. A mixture of acetic, propionic and butyric acids at concentrations equivalent to those found in the effluent (16.1, 6.7 and 3.3 mM, respectively) reduced the transpiration, fresh weight production and root fibrosity of Typha seedlings in nutrient solution, the effect being more severe at high salinity. Wheat germination bioassay results showed that at the concentrations found in the effluents, phytotoxicity was primarily caused by acetate with a smaller contribution from proprionate. Relatively high concentrations of fatty acids were lost from the macrophyte filter system within a few hours although they remained stable in an open dilution tank for at least one week. In laboratory incubation experiments algae occurring in the aufwuchs on the gravel substrate played a critical role in dissipation by supplying oxygen to associated bacteria, rather than by heterotrophy, since decay was inhibited by addition of the photosynthetic inhibitor, terbutryne. The effects of flow rate on the operation of the macrophyte system should by investigated with the objective of minimizing phytotoxicity where this is a limiting factor. Gravel size should reduced to maximize surface area, providing that hydraulic conductivity can by maintained, because high loadings of algae in the epipelic slime

at the gravel surface contributes to the efficient operation of the system. (Collier-IVI)
W85-04489

T2-COLIPHAGE UPTAKE BY MOSQUITO LARVAE,
Kinneret Limnological Lab., Tiberias (Israel).
M. Gophen.
Water Research, Vol. 19, No. 1, p 89-91, 1985. 4 Tab, 18 Ref.

Descriptors: *Mosquitos, *Wastewater treatment, *Coliphages, *Viruses, Degradation, Disinfection, Microorganisms.

Degradation of T2-Coliphage viruses by mosquito larvae was demonstrated in filtered raw domestic sewage. The presence and density of mosquito larvae in waters of sewage purification systems is not limited by dissolved oxygen because they utilize atmospheric gas. Uptake of T2-Coliphages by mosquito (Culex pipiens molestus) larvae was measured at three temperatures and different concentrations of Coliphages. Larvae were fed on three types of food: either H-3 or C-14 labelled T2-Coliphage separately, or a mixture of both suspended in filtered raw sewage at 20, 25, or 30 C. One cpm was found to be equivalent to 2.1 Coliphage for C-14 or 40,000,000 Coliphage for H-3. Control experiments, using larvae killed with formaldehyde, showed that very low absorption of radioactive material to the larvae occurred, amounting to only 0.1-0.5% of the Coliphage ingested by living larvae. All the H-3 labelled Coliphages depleted from the media when fed as a single food source accumulated in the larvae. The C-14 labelled material that was depleted form the media but not accumulated in the larvae (90%) was probably ingested then egested and sank to the bottom with fecal pellets and/or partly respired. Based on C-14/H-3 ratios in larvae relative to the feeding media, viruses were not only ingested but also degraded and assimilated by the larvae. Mosquito larvae should be considered as a useful component in sewage purification systems. In areas where diseases carried by adult animals are common, prevention of adults emergence should be carried out. (Collier-IVI)
W85-04493

INFLUENCE OF THE CHARGE DENSITY OF CATIONIC POLYELECTROLYTES ON SLUDGE CONDITIONING,
Istituto di Ricerca sulle Acque, Bari (Italy).
G. Tiravanti, F. Lore, and G. Sonnante.
Water Research, Vol. 19, No. 1, p 93-97, 1985. 5 Fig, 2 Tab, 18 Ref.

Descriptors: *Wastewater treatment, *Sludge conditioning, *Coagulation, *Polyelectrolytes, Electrolytes, Colloids, Chemical coagulation.

Commercial polyelectrolytes, generally used for sludge conditioning, are poorly characterized as far as the charge density is concerned. Five cationic polyelectrolytes at different strength, having similar molecular weight (1-5 million), were selected. Their charge densities were measured by a conductometric method and found to be between 1.5 and 3.7 mequiv/g. These polymers were used for conditioning five different sludges produced in full-scale wastewater treatment plants and the optimal doses were correlated to the sludge concentration taking into account the values of the charge density. The quite good correlation found, according to the theory of charge neutralization of colloids of opposite sign, seems to be a useful criterion for predicting the optimum polyelectrolyte dose for sludge conditioning. (Author's abstract)
W85-04494

PERFORMANCE CHARACTERISTICS OF THE ANAEROBIC BAFFLED REACTOR,
Stanford Univ., CA. Dept. of Civil Engineering.
A. Bachmann, V. L. Beard, and P. L. McCarty.
Water Research, Vol. 19, No. 1, p 99-106, 1985. 5 Fig, 6 Tab, 18 Ref.

Descriptors: *Anaerobic conditions, *Baffled reactors, *Wastewater treatment, Chemical oxygen demand, Fixed film reactors, Methane, Bacteria, Costs.

An anaerobic sludge blanket process, termed the anaerobic baffled reactor (ABR), has been developed and shows promise for industrial wastewater treatment. It combines the advantages of high stability and reliability with a high void volume. The risk of clogging and sludge bed expansion with resulting high microbial losses is reduced and there is no need for special gas collection or biological solids separation systems. Organic loadings as high as 36g COD/l/day have been achieved with COD removal rates of more than 24g COD1/l/day and methane production rates exceeding 6 volumes per day per unit volume of reactor. The hypothesis, that the ABR may be adequately modeled as a fixed-film reactor, has been supported. Therefore, a unified approach, based on fundamentals of bacterial kinetics and mass transport, appears useful for modeling this and similar systems. Pilot plant studies are necessary to determine the scaling factors of the system as well as the overall efficiency and costs. (Author's abstract)
W85-04495

BOWHOUSE SEWERAGE AND SEWAGE DISPOSAL SCHEME OF FIFE REGIONAL COUNCIL,
K. C. Wilson.
Water Pollution Control, Vol. 82, No. 1, p 42-48, 1983. 2 Fig, 2 Tab, 11 Ref, 2 Append.

Descriptors: *Wastewater treatment facilities, *Bowhouse Works, *Scotland, Wastewater, Pumps, Wastewater treatment.

A centralized wastewater treatment plant was developed at Bowhouse for the Burghs of Ladybank, Auchtermuchty and Falkland, and three small villages in Fife County. Centralized treatment necessitated pumping sewage from each of the three existing works to a point adjacent to the River Eden. The Bowhouse Works was completed, apart from a few minor works and the installation of a sludge thickening plant, in December 1980. The startup troubles experienced with the pumps and blockages encountered in the Auchtermuchty rising main have largely been resolved, and the new works, which is not yet up to full design capacity is currently producing a mean final effluent quality of 6 mg/l BOD and 5 mg/l SS with maxima of 12.5 mg/l and 87.5 mg/l, respectively. This is well below the consent limits set by the Tay RPB. (Baker-IVI)
W85-04508

USE OF PERFORMANCE INDICATORS IN SEWAGE TREATMENT APPRAISAL,
Yorkshire Water Authority (England).
H. B. Tench.
Water Pollution Control, Vol. 82, No. 1, p 61-76, 1983. 8 Fig, 11 Tab.

Descriptors: *Wastewater treatment, *Quality control, *Performance indicators, Management, Evaluation, Planning, Economic aspects, Biochemical oxygen demand, Costs.

It is the responsibility of operational management to achieve a satisfactory standard of service at a minimum cost. Performance indicators help management to achieve these goals by standardizing the ways of measuring levels of service and costs and by measuring service and cost and calculation of averages to provide norms against which performance may be judged, and to give a means of progressively improving individual plant performance so that the overall average also improves. The indicators are divided into resource utilization indicators intended to provide information on the cost structure and the resources which create those costs; and plant performance indicators to give information on the standard of service supplied. Work performance indicators may give insight into the reasons for cost and performance variations. An application of performance indicators to Southern Division, Yorkshire Water Authority is offered as an example of the use of indicators. (Baker-IVI)
W85-04510

MEASUREMENT OF THE PERFORMANCE OF SEWERAGE SYSTEMS AND ASSOCIATED HYDRAULIC STRUCTURES - RECENT DEVELOPMENTS,
A. J. Baughen, and A. R. Eadon.
Water Pollution Control, Vol. 82, No. 1, p 77-86, 1983.

Descriptors: *Sewer systems, *Wastewater facilities, *Data acquisition, Monitoring, Hydraulic structures, Recorders, Measuring instruments, Maintenance, Computers.

There is a shortage of information on the performance of existing sewerage systems and the more extensive use of direct measurement is suggested as the means of providing additional data on this area of wastewater treatment evaluation. Available monitoring devices discussed include hydraulic devices, chemical dilution tests, velocity and depth measurements, and the electromagnetic gauge. Recorders should be capable of being left for long periods to reduce attendance costs. They should be vandal proof and not draw attention to themselves nor require expensive underground chambers. While low-powered for safety reasons, they should be cheap to operate and not require frequent changing of expensive dry batteries or specially printed charts. The time base should be accurate and not require correction. While giving a rapid analogue reading it should not require tedious measurement to obtain digital readings and integration, either for the whole period measured or for shorter periods. The cost of the apparatus should not be so high as to make the benefits of recording dubious on a cost-benefit basis. There should be provision for recording events only. The instrument should be readily portable. The results obtained should be reproducible and as accurate as can be obtained. The frequency of the record should be sufficient and comparable with a pen chart. A display on the instrument should show the signal being recorded for setting up and in situ checks. Micro computers may be of use in this area of work. (Baker-IVI)
W85-04511

RESURRECTION OF DEIGHTON SEWAGE TREATMENT WORKS,
Yorkshire Water Authority (England).
C. N. L. Cree.
Water Pollution Control, Vol. 82, No. 1, p 87-101, 1983. 8 Fig, 2 Ref.

Descriptors: *Wastewater treatment facilities, *Deighton, *England, Industrial wastewater, Chemical industry, Textile industry, Sludge disposal, Maintenance, Pretreatment.

Deighton Sewage Treatment Works, located downstream of Huddersfield on the River Colne, had progressively been overloaded by chemical industry and woolen mill effluents. By 1974, Deighton Sewage Treatment Works was inadequately maintained and not functioning correctly. The works inlet control penstock was seized in the open position, jettisoning a substantial proportion of the crude sewage directly to stream. All tanks and channels were full of septic sludge which was recycling around the works to the extent that effluents were often worse than influents. The hydraulic capability of the works was totally inadequate and three major overflows were continually in operation. In 1974, new managers took over. The first task of management was to rapidly analyze and interpret the components of the problem. Sea disposal operations were undertaken for the humus sludge. The toxic chemical sludges were pressed for disposal at a toxic waste disposal site. The municipal sludge was septic, unscreened, and contained detritus; as a result, it was unpumpable, and had to be hosed and physically chopped up before it would run to the pumps. Existing facilities were refurbished or recommissioned, and plans were made to expand the existing capacity. Chemical manufacturers were required to pretreat wastes. (Baker-IVI)
W85-04512

BOD REMOVAL EFFICIENCIES IN TWO STABILIZATION LAGOONS IN SERIES IN MALAYSIA,
Engineering-Science, Inc., Arcadia, CA.
R. M. Bradley.
Water Pollution Control, Vol. 82, No. 1, p 114-122, 1983. 5 Fig, 1 Tab, 26 Ref.

Descriptors: *Stabilization lagoons, *Wastewater treatment, Malaysia, Kuala Lumpur, Wardieburn Lagoons, Biochemical oxygen demand, Evaluation, Design criteria.

Stabilization lagoons are widely used in tropical countries and elsewhere as an effective and economic means of treating domestic sewage. Many lagoon systems are capable of operation at significantly higher efficiencies than those predicted by the design criteria. An analysis of the operating data for the Wardieburn lagoon system in Kuala Lumpur, Malaysia is offered and the recorded biochemical oxygen demand (BOD) removal rates are compared with those predicted by various design criteria. The Wardieburn lagoon system comprizing two lagoons of equal surface area and depth in series reduces the BOD and SS levels of the feed sewage by 79 and 50%, respectively. Average BOD reduction of 65 and 39% occur in the primary and secondary lagoons, respectively. Algae can contribute 50-60% of the BOD in the secondary lagoon effluent and about 10% of the BOD in the primary lagoon effluent. The BOD removal rate constants in the primary and secondary lagoons at the mean operating temperature of 29 C are 0.423 and 0.165/d, respectively. The BOD removal rate constant in the secondary lagoon is only 39% of that in the primary lagoon. The primary lagoon functions as a facultative lagoon most of the time, although the anaerobic layer may extend close to the surface for short periods. The combined Wardieburn lagoon volume of 14,600 cu m is only 24% of that required to achieve a similar BOD removal in a single facultative lagoon designed on a conservative basis. Maximum BOD removal efficiency in a series system can be achieved by maximizing the BOD load on each lagoon. (Baker-IVI)
W85-04515

INDUSTRIAL EFFLUENT TREATMENT AT SEWAGE-TREATMENT WORKS: THE TADCASTER EXPERIENCE,
Yorkshire Water Authority (England).
M. A. Tidswell, J. A. Hudson, and K. D. Staples.
Water Pollution Control, Vol. 82, No. 2, p 227-242, 1983. 4 Fig, 2 Tab, 4 Ref, 2 Append.

Descriptors: *Wastewater treatment, *Tadcaster, *England, *Breweries, Odor control, Industrial wastewater, Water pollution control, Activated sludge process, Automation, Data processing.

During 1970-1972, new sewers were built in Tadcaster specifically to convey industrial effluents from three breweries by gravity to a new industrial pumping station. The effect of this was to concentrate pollution from the town and from the breweries in a comparatively short length of the River Wharfe downstream from the sewage treatment works. The flow of the river at the outfall is greatly influenced by the ebb and flow of the tide, and with the substantial discharge of effluent with a high oxygen demand there have been serious fish kills due to a number of coincident factors. Efforts have been made to control pH and nutrient release, improve sludge handling, deodorize wastes, and control the entire system through proper instrumentation. The Tadcaster experience has shown that it is possible to resolve effectively major industrial effluent pollution problems in a small town with willing cooperation between a major group of industrialists and their water authority. The process evaluations and the detailed design all indicate that the oxygen-enriched activated-sludge process is effective, economic and an attractive method of biologically treating a strong carbohydrate effluent such as a brewery effluent. The operation of the plant is expected to confirm the assessments made in design that further material process advantages and economies might be derived from the balancing of flows and loads to high rate treatment plants. The completed plant embraces several aspects of advanced technology not the least being the control, automation and data processing equipment which at Tadcaster is regarded as appropriate technology. (Baker-IVI)
W85-04521

TIP LEACHATE TREATMENT USING HYDROGEN PEROXIDE,
Interox Chemicals Ltd., Widnes (England).
J. A. L. Fraser, and A. F. E. Sims.
Water Pollution and Control, Vol. 82, No. 2, p 243-255, 1983. 1 Fig, 9 Tab, 45 Ref.

Descriptors: *Leachates, *Wastewater treatment, *Hydrogen peroxide, *Sulfides, Microorganisms, Solid waste disposal.

Water collected on landfill sites, and rivers or streams receiving tip leachates, are frequently contaminated with sulfides giving rise to noxious odors and black coloration. Heavy microbial growths in receiving waters have also proved a nuisance. Hydrogen peroxide (35% w/w) has been used to combat these problems. Hydrogen peroxide has proved easy to handle, readily miscible with water, selective in application and of particular value in emergency situations. It is complementary to aeration systems for full leachate treatment, environmentally acceptable and gives rise to neither polluting by-products nor deleterious bioaccumulation. It has destroyed sulfide odors in leachates, cleared lagoons of black iron sulfide and reduced filamentous bacterial and fungal growths in receiving streams. Application methods in use include dosing at pumping stations by gravity feed or injection, dilution and spraying, and floating peroxide across the surface of small lagoons using wind action. On large lagoons hydrogen peroxide has been injected into the intake or discharge pipes of static diesel-driven pumps recirculating and jetting leachate. Peroxide has been gravity fed into channels during leachate transfer, or in emergencies can be spread on lagoons from a boat. These techniques have been adopted by many private landfill operators and UK County Councils. Four case histories are presented to highlight initial operational problems. The use of hydrogen peroxide is demonstrated and improvements in leachate quality described. (Author's abstract)
W85-04522

SCREENING: A NEW APPROACH,
R. W. Little, and G. L. Symes.
Water Pollution Control, Vol. 82, No. 2, p 256-262, 1983. 1 Fig, 6 Tab, 2 Ref.

Descriptors: *Mechanical equipment, *Screens, *Contra Shear, Wastewater treatment, Outfalls, Solids.

Probably the most troublesome area in the operation of a sewage treatment works is the preliminary treatment plant, the removal of screenings and grit. Another area where screenings are a problem is in sea outfalls. The Contra-Shear screen is described and its use depicted. The principle of operation is that the inflow is introduced via a surge chamber and weir onto the inside of a counter-rotating wedgewire screen with the wires running horizontal to the unit axis. The shear velocity created by the rotating and the tangential introduction of the flow onto the screen face gives definitive solids separation and increases hydraulic capacity for a given screen size. The solids agglomerate at the bottom of the screen and are moved through a drainage area before being discharged from the unit by the rotary motion and segmented bars welded to the inside drum face. A series of washwater jets operate intermittently to clean the screen and there is no difficulty in using the screened effluent as washwater. The use of the Contra Shears in sewage-treatment works may reduce the normal maintenance requirements on the downstream processes and lead to savings in manpower and costs. On sea outfalls, they could be used to produce an effluent equivalent to or better than a drum screen, while discharging the screening in an easily handleable form. (Baker-IVI)
W85-04523

NUTRIENT REMOVAL TRIALS AND BIOASSAY EVALUATION AT BUDDS FARM SEWAGE-TREATMENT WORKS, HAVANT,
Southern Water Authority, Worthing (England).
G. S. Ford, R. L. G. Rees, P. G. Soulsby, and D. Lowthion.
Water Pollution Control, Vol. 82, No. 3, p 381-391, 1983. 4 Fig, 4 Tab, 5 Ref.

Descriptors: *Nutrient removal, *Havant, *England, *Wastewater treatment, Nitrogen, Phosphorus, Denitrification, Flow, Management, Water pollution control, Environmental effects.

Budds Farm sewage-treatment works is situated at Havant in Hampshire and the effluent discharges directly to the northeast corner of Langstone Harbor. Rapid growth in the area has brought about a tremendous increase in the flow to the works which increased dangers to the ecology of the region. The only practical solution seemed to be a conversion process to remove nitrogen and phosphorus from the effluent. Conventional denitrification was introduced by anoxic reaction between settled sewage and returned activated sludge at the activated-sludge plant. A significant quantity of phosphate and nitrate were removed by this process. Removal of nitrogen from unsettled filter effluent in the anoxic zone of the aeration plant was successfully achieved, increasing the quantity of nitrogen removed from the total effluent. Ferric sulfate added to the mixed liquor in the aeration plant is used to partially remove phosphate without reducing the efficiency of the normal treatment processes. Bioassay tests and investigations in the harbor have demonstrated that phosphate removal from Budds Farm effluent is not necessary and this expensive process has been discontinued. Nitrogen removal is being continued as a routine process at the plant. (Baker-IVI)
W85-04526

OPTIMIZATION OF COLESHILL ACTIVATED-SLUDGE PLANT OPERATING CONDITIONS,
Severn-Trent Water Authority (England).
B. Fryer, and P. Musty.
Water Pollution Control, Vol. 82, No. 4, p 443-456, 1983. 8 Fig, 3 Tab, 7 Ref, 3 Append.

Descriptors: *Wastewater treatment, *Optimization, *Activated sludge process, *Denitrification, Dissolved oxygen, Aeration, Ammonia, Nitrates.

Unit 3 of the Coleshill sewage-treatment plant was commissioned in stages when housing developments led to much greater flow than could be afforded full treatment by the existing works. Unit 3 was not designed to achieve nitrification. Steps were taken to derive the optimum performance from the Coleshill sewage-treatment works, the goals being to produce a well nitrified effluent and to minimize the loss of solids resulting from denitrification occurring in the secondary settlement tanks. A substantial improvement in the degree of nitrification at the works has been achieved by introducing continuous dissolved oxygen monitoring, increased plug flow and load equilibration. Effluent ammonia N concentrations have frequently been less than 0.5 mg/l. The introduction of anoxic zones at the inlets of aeration tanks has resulted in an overall reduction in effluent nitrate nitrogen levels of about 20 mg/l. Rising sludge due to denitrification has been considerably reduced. (Baker-IVI)
W85-04590

ACCELERATED COLD DIGESTION: A NEW LOOK AT AN OLD TECHNIQUE,
Yorkshire Water Authority (England).
P. Lowe, and S. Williamson.
Water Pollution Control, Vol. 82, No. 4, p 457-470, 1983. 18 Fig, 4 Ref.

Descriptors: *Sludge digestion, *Wastewater treatment, *Cold digestion, Anaerobic digestion, Sludge treatment.

In the Lower Calder Area of the Yorkshire Water Authority (England) there are several small to

medium sized works serving populations ranging from 100 to 20000 and one large works at Calder Vale serving 75000. In 1974 a centralization of sludge treatment was put into practice and the tankering of sludge into the Calder Vale works from the other plants began. Sludge treatment was achieved by mesophilic digestion, after which sludge is stored for about 3 months in earth bank lagoons prior to disposal as liquid to agricultural land. To handle increasing loads of waste volume, several small scale experiments were set up to determine if mesophilic digested sludge could be blended with raw sludge in a controlled process environment to accelerate cold digestion and thereby reduce the time scale to achieve a manageable system. Experimental results at Calder Vale, coupled with field trials at Crofton and Great Cliffe showed that the potential to stabilize raw sludge using already mesophilic digested sludge can be a further extension of the digestion process. This mixing did not reduce the need to provide more intensified mesophilic digesters, but did enlarge their scope and, hence, make any economic considerations as to their provision more attractive. As far as the treatment of sludge at small works is concerned, it reduces the need to transport all the sludge to a central works since at least 33% of it can be disposed of to atmosphere in a gaseous state. Much work remains to be carried out to optimize the accelerated cold digestion concept but, it provides the operator with a useful route towards final sludge disposal as the study continues. (Baker-IVI)
W85-04591

AEROBIC TREATMENT IN 'OXITRON' BIOLOGICAL FLUIDIZED BED PLANT AT COLESHILL,
Severn-Trent Water Authority (England).
G. Hoyland, and P. J. Robinson.
Water Pollution Control, Vol. 82, No. 4, p 479-493, 1983. 11 Fig, 4 Tab, 12 Ref.

Descriptors: *Wastewater treatment, *Aerobic digestion, *Fluidized beds, Biological wastewater treatment, Sand, Biofilms, Activated sludge process.

The performance and economics of the Oxitron System for use in the treatment of settled sewage are evaluated. The relationship between the concentration and size of sand grains in reactor and the physical properties of the biofilms that grow on grains is considered. The concentration of biological solids in a biological fluidized bed (BFB) is strongly related to the upward velocity and grain size of the sand, but is insensitive to the concentration of sand. At the same organic loading, an Oxitron BFB plant installed at Coleshill had an inferior performance compared to the conventional activated-sludge (AS) plant. At low loadings the BFB and AS effluents contained similar suspended solids concentrations, but the soluble BOD concentration of BFB effients were comparatively high. At high loading, the BFB effluent had a similar soluble BOD to the AS effluent but contained a comparatively high concentation of AS. The poor BFB performance may be partly attributed to growth in the bed of over-sized particles comprising thick biofilms containing inactive microorganisms. The proprietory oxygenator associated with the BFB plant can input to the reactor oxygen equivalent to a concentration of 35 mg/l. The consumption of oxygen in BFB and AS plants is similar. An economic comparison suggests that carbonaceous oxidation in a BFB plant at most sewage-treatment works would probably be more expensive than treatment in a conventional AS plant. Operating costs of the BFB plant for the provision of gaseous oxygen and electricity consumption probably account for about 50% of the total costs. (Baker-IVI)
W85-04593

A/O PROCESS - BIOLOGICAL TREATMENT WITH NUTRIENT REMOVAL,
A. G. Best.
Water Pollution Control, Vol. 82, No. 4, p 494-500, 1983. 5 Fig, 3 Tab, 5 Ref.

Descriptors: *Biological wastewater treatment, *Nutrient removal, Phosphorus, Denitrification, Phosphorus removal, Aerobic conditions, Anaerobic conditions, Wastewater treatment.

A biological system for biochemical oxygen demand, phosphorus and nitrogen removal has been successfully developed. This process, the A/O process, is a single sludge, suspended-growth system which combines a staged anaerobic section, deficient in both dissolved and chemically-bound oxygen, with a conventional stage aerobic section. In the oxic section, nitrification can be accomplished by operating at a properly selected solids retention time. When denitrification is required an anoxic section, deficient in dissolved oxygen but not nitrogen oxides, is included between the anaerobic and oxic zones. An internal recycle is used to transfer nitrified mixed liquor from the oxic section back to the anoxic section. Influent wastewater is mixed with recycled sludge from the secondary clarifier at the front end of the anaerobic section. The mixed liquor then flows to the anoxic section, if present, and then to the oxic section. The anaerobic zone provides the selective stress for generating high phosphorus removing organisms. The phosphate molecules are linked together by energy-rich phosphoanhydride bonds whose free energy of hydrolysis is greater than that released in the ATP to ADP reaction. (Baker-IVI)
W85-04594

PRACTICAL ASPECTS OF ENERGY SAVING IN WASTEWATER DISPOSAL,
Humphreys (Howard) and Sons, London (England).
G. F. G. Clough.
Water Pollution Control, Vol. 82, No. 4, p 510-517. 2 Fig, 4 Ref.

Descriptors: *Wastewater treatment, *Treatment plants, *Energy, *Costs, Economic aspects, Pumps, Monitoring, Management planning, Economic efficiency.

Energy may be saved in wastewater disposal systems without disproportionately increasing the use of other resources. In practice there is considerable scope for doing this because many plants are not operating under the conditions for which they were designed. The cost of energy has increased relative to other resources since many plants were originally designed, and is expected to increase still further. The practical problem is how to modify an existing plant at minimum cost to suit the conditions existing at the present time and those likely to occur in the immediate future. The more promising areas for action are: matching the plant to the load; pumping; aeration; instrumentation; the use of digester gas; and space heating. One of the more pressing needs is a general improvement in flow measurement. Monitoring is an essential part of energy saving but if it is based on inaccurate flow measurement the results may be useless or misleading. Small pump efficiency is generally low but improvements may be hard to quantify. Another future developmemt is that automatic control systems will make an increasing contribution to energy saving. (Collier-IVI)
W85-04595

TREATMENT OF FERRUGINOUS GROUND WATER FROM AN ABANDONED COLLIERY,
G. A. Best, and D. I. Aikman.
Water Pollution Control, Vol. 82, No. 4, p 557-566, 1983. 6 Fig, 13 Tab, 10 Ref.

Descriptors: *Mine drainage, *Wastewater treatment, *Coal mines, Scotland, Biological treatment, Alkaline water, Ferruginous mine drainage, Groundwater, Sludge drying.

Investigation into the treatment of an alkaline and ferruginous type of discharge are described. The discharge originated from an abandoned colliery in Scotland. The principle chemical characteristics of alkaline and ferruginous discharges is that, after aeration, all the ferrous salts are converted into the insoluble ferric form which precipitates as hydrated ferric oxide. The method of treatment involves aeration by a stepped cascade followed by a biological filter and then settlement of the insoluble iron for 18 hr in shallow lagoons. The drainage of the sludge to a handleable consistency takes about 1 month, and could be carried out either in the lagoons or on separate drying beds. This treatment process will reduce the iron content of the 125 cu m/hr discharge by about 75% from the original 28 mg/l and will produce an effluent which will not jeopardize the good quality fishery in the receiving River Ayr. (Baker-IVI)
W85-04596

SALINE IRRIGATION WATER: EFFECTS ON SOIL CHEMICAL AND PHYSICAL PROPERTIES,
Texas Tech Univ., Lubbock. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 3C.
W85-04618

FILTER FOAM - PERFECT IN MANY FIELDS (FILTERSCHAUM - PERFEKT IN VIELEN BEREICHEN),
For primary bibliographic entry see Field 5F.
W85-04632

DRIER SLUDGE ENDS LANDFILL LEACHING CONCERNS,
Wastewater Treatment Plant, Brewer, ME.
M. Taylor.
Water Engineering and Management, Vol. 131, No. 13, p 30-31, December, 1984. 2 Fig.

Descriptors: *Sludge treatment, *Belt filter press, *Sludge drying, Wastewater treatment, Sludge disposal, Dewatering.

Built to handle a difficult influent consisting of typical municipal wastewater combined with concentrated industrial waste, the treatment plant serving Brewer, Maine, had a serious sludge dewatering problem. The poorly dewatered sludge, disposed of in a landfill, was seriously aggravating existing leaching problems. In 1981 the effluent standards imposed by the State of Maine's Department of Environmental Protection on plant discharges were being threatened. Spring coil vacuum filters used for nearly a decade in the plant were capturing only about 50% of the solids in the waste activated sludge dewatering process. By switching to a belt filter press 85% of the daily 8 dry tons of solids generated from the combined industrial municipal waste activated sludge is now captured. Energy savings have amounted to about 28,000 kwh/month. (Baker-IVI)
W85-04650

OXYGEN INJECTION CUTS ODORS,
Airco Industrial Gases, Murray Hill, NJ.
E. Mozell.
Water Engineering and Management, Vol. 132, No. 1, p 40 and 42, January, 1985. 1 Fig, 1 Tab.

Descriptors: *Oxygen, *Wastewater treatment, *Odor control, Management, Oxidation.

When injected into raw sewage, pure oxygen can help end noxious odors and improve the efficiency of subsequent sewage treatment processes. Such injection systems are simple and easy to install. One of the most recent applications was to assist in controlling odors at a newly expanded wastewater treatment plant. The source of problem odors at the plant was found to be four new 100 ft diam, 32 ft deep units in which the waste stream is trickled through honeycombs of plastic filter media. Aerobic bacteria on the surface of the media convert soluble organic matter into settleable organic matter. Air is circulated through the filters which serve as a release point for the sewage entrained odor compounds and as a point source odor generator. While a long term solution is being sought, influent sewage is being diluted with oxygenated recycled wastewater from the nitrification process. Another of the responses to the odor problem was to install an oxygen injection system, where oxygen is injected into the influent mixture at the discharge side of the main pumping station. The feed rates are set manually by the personnel and range from 1,000 to 3,000 SCF/hour. While the

odor has not been eliminated entirely, these systems have been helpful in diminishing the problem. (Baker-IVI)
W85-04652

TWO-PHASE ANAEROBIC FERMENTATION OF LIQUID SWINE WASTE TO METHANE,
Budapesti Mueszaki Egyetem (Hungary).
T. Czeh, L. Czako, J. Toth, and R. P Tengerdy.
Biotechnology and Bioengineering, Vol. 26, No. 12, p 1425-1429, December, 1984. 6 Fig, 1 Tab, 14 Ref. NSF grant INT 820-3996.

Descriptors: *Animal wastes, *Methane, *Anaerobic digestion, *Wastewater treatment, *Manure, Volatile solids, Lignin, Fatty acids, Proteins.

Anaerobic digestion is the most flexible means of swine waste disposal; it satisfies the requirements of both economic recycling and environmental protection. Two-phase anaerobic digestion of liquid swine manure has been developed with options for single-cell protein (SCP) or methane production. In the acidogenic phase at two to four days retention time, and 2.5-7.0% dry matter (DM) concentration, 8-46% of the volatile solids was solubilized. Maximum reactor capacity was 3.86 g/L at 7.0% DM concentration, but optimal operation was achieved at 4.5% DM concentration at four days retention time. The second methanogenic phase was operated continuously and had a maximum specific methane production rate of O.70 L/L day at 12 days retention time. With recirculation, the rate was 1.16 L/L day at 8.5 days retention time with 52.7% conversion of organic matter. Maximum digestibility was 66% of the lignin free organic matter. Efficiency of acidogenic solubilization of volatile solids in liquid swine waste linearly decreases with the load. Selection of the optimal operation point depends on the intended use of the process. If maximum gain of gas or volatile fatty acids for SCP is the goal and the value of the substrate is slight, optimization for maximum reactor capacity is warranted. (Collier-IVI)
W85-04659

BIOLOGICAL DENITRIFICATION IN A FLUIDIZED BED,
Indian Inst. of Tech., Bombay. Dept. of Chemical Engineering.
N. K. Narjari, K. C. Khilar, and S. P. Mahajan.
Biotechnology and Bioengineering, Vol. 26, No. 12, p 1445-1448, December, 1984. 5 Fig, 1 Tab, 16 Ref.

Descriptors: *Denitrification, *Fluidized bed process, *Wastewater treatment, *Biological treatment, Biological wastewater treatment, Nitrates, Nutrient removal.

In a fluidized bed reactor, wastewater is sent upwards at a velocity faster than the minimum fluidization velocity and the intensive organism growth on the carrier particle consumes the biodegradable waste contaminants present in the wastewater. A fluidized bed biofilm reactor using sand as the carrier particle was employed to study the effects of superficial velocity on the removal of nitrates as well as on the growth of the biofilm. Velocity was found to affect significantly both nitrate removal and biofilm growth. The lowest superficial velocity used, 2.5 cm/s, was ca. 3.5 times the minimum fluidization velocity; the nitrate removal rate (g/h) was 0.85. The nitrate removal rate was maximum, 1.39 g/h, for a velocity of 4.2 cm/s. An increase in velocity to 5.4 cm/s led to a decrease in removal rate, 1.24 g/h. Rate of growth of biofilm was highest at a velocity of 4.2 cm/s. As the velocity increases, the increased drag and shear on the bioparticles sloughs off a portion of the attached film and, consequently, the film thickness decreases. The optimum mass velocity at which the thickness of the biofilm was maximum was ca. 2500 kg/sq m/min. An analysis based on heterogenous catalysis was used to describe the reaction and mass transport in the denitrification process; the hydrodynamic aspects are related to fluidization principles. The differential material balance balance equations for the substrate can be written in two phases: biofilm and bulk liquid. These two weakly coupled differential equations can be solved simultaneously with the proper boundary conditions. Both steady-state and startup experimental data were used to test the correlation obtained from the analysis. The substrate effluent concentration was correlated with various dimensionless numbers; the correlation obtained by analysis fits the data very well. Using the analysis, one can estimate the efficiency of biological denitrification in a fluidized bed under known operating conditions. (Collier-IVI)
W85-04660

MICROBIAL HETEROTROPHIC ACTIVITY ASSESSMENT IN A WASTE-WATER TREATMENT SYSTEM,
National Inst. for Water Research, Pretoria (South Africa).
D. F. Toerien.
Ergebnisse der Limnologie, Vol. 19, p 305-312, December, 1984. 5 Tab, 15 Ref.

Descriptors: *Microorganisms, *Wastewater treatment, *Heterotrophic bacteria, *Glucose, Bacteria, Aufwuchs, Surface sediments, Macrophytes, Animal wastes, Cattails, Bacterial physiology.

The heterotrophic activities of different microbial communities, viz. those of the bacterioplankton, 'Aufwuchs', surface sediment layer, a sludge (deposited solids) layer and a surface film at the water-air interface of an artificial macrophyte bed used for the treatment of piggery effluent were quantified. The Wright and Hobbie (1966. Ecology, 47: 447-464) method (with the measurement of labeled-CO2 evolution) was adapted to determine the glucose uptake kinetics of the bacterioplankton, sludge layer, sediment surface and surface film at the water-air interface. The method worked well despite the fact that very high Vmax values (> 3000 micro g/l/h) and very short turnover times (< 0.01 h) were encountered for glucose uptake in the water column and/or the sludge layer. Disturbance of 'Aufwuchs' increased its glucose uptake and changed its glucose uptake kinetics. Consequently a method was developed whereby pieces of leaves of Typha domingensis with intact 'Aufwuchs' were used in assessment of labeled-glucose uptake and mineralization. The coefficient of variation of the rate of glucose uptake by 'Aufwuchs' in different locations of the macrophyte was approximately 40%. The above methods can be recommended for the quantification of the microbial activities of waste-water systems. (Author's abstract)
W85-04706

SHORT-TERM UPTAKE OF HEAVY METALS BY PERIPHYTON ALGAE,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
For primary bibliographic entry see Field 5B.
W85-04721

CHEMICAL FLOCCULATION FOR SUSPENDED SOLIDS REMOVAL AT REMOTE MINE SITES,
Commonwealth Technology, Inc., Lexington, KY.
J. S. Tapp, B. J. Barfield, and M. L. Griffin.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1332-1338, September-October, 1984. 7 Fig, 5 Tab, 13 Ref.

Descriptors: *Flocculation, *Suspended solids, *Mine drainage, *Chemical coagulation, Settling basins, Sedimentation, Polyelectrolytes, Water treatment.

Meeting applicable suspended solids effluent limitations with simple gravity settling may be difficult depending on the nature of the suspended material to be removed. The effectiveness of using polyelectrolyte chemical flocculation agents for enhancing the removal of suspended solids in runoff from mined areas was investigated in pilot scale tests with the goal of improving the effectiveness of sediment ponds with inflow concentrations typical of remote sediment ponds. These studies show that chemical flocculants enhance removal of sediment at high concentrations and that adequate mixing is important to the process. Adequate mixing was obtained by a passive system composed of a corrugated pipe for high energy initial mixing and a baffle system for lower energy final mixing. In a constant flow test run, the total suspended solids concentration was reduced to less than 45 mg/l, while without chemical treatmemt more than 300 mg/l was present in the outflow; coagulant concentrations used ranged from 0 to 40 mg/l. (Collier-IVI)
W85-04730

IRRIGATION OF SWINE LAGOON EFFLUENT ONTO PINE AND HARDWOOD FORESTS,
South Carolina Agricultural Experiment Station, Clemson.
R. O. Hegg, A. T. Shearin, D. L. Handlin, and L. W. Grimes.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1411-1418, 1984. 6 Fig, 7 Tab, 11 Ref.

Descriptors: *Wastewater irrigation, *Animal wastes, *Forests, Potassium, Phosphorus, Calcium, Magnesium, Effluents, Wastewater disposal.

Growth responses of a loblolly pine plantation and a mixed hardwood stand were measured to the application of swine lagoon effluent. The capacity of the forest soil to assimilate the organic matter and nutrients of the swine lagoon effluent was also determined. There were significant accumulations of P, K, Ca, and Mg in the forest soils from nearly all application rates of swine effluent. Mature pine trees (45 yr old) did not show increased diameter growth after five years of swine effluent applications, but there was a significant height increase at the highest application rate of 81 cm/yr. Mature hardwood shows a significant increase in growth at all swine effluent application rates. Application of swine effluent onto forestland is an appropriate method of disposal because of the convenience and management features. (Baker-IVI)
W85-04741

NEW IDEAS RESHAPING TREATMENT TECHNOLOGIES,
Lorenz (William T.) and Co., Boston, MA.
W. T. Lorenz.
American City and County, Vol. 100, No. 2, p 56 and 61-62, February, 1985. 1 Fig.

Descriptors: *Wastewater treatment, *Maintenance, Management, Operation, Water reuse, Conservation, Planning, Decision making, Computers.

Public officials are evaluating innovative, and cost-effective technologies, as well as exploring alternative financing methods for wastewater treatment. Package wastewater treatment plants are one solution to sewage treatment problems. Membrane technologies, as part of package treatment plants, are also in greater demand where higher quality effluent is desired, perhaps for recycling or reuse. There is a growing demand for instrumentation and sampling systems for monitoring the compositions and concentrations of substances found in influent resulting from industrial wastes streams. Computer based services and software for wastewater treatment facilities are fast becoming an important industry. For small treatment plants, the trend is toward onsite microcomputer operations that can reduce staff requirements by as much as 75%. Significant proposals in water recycling are now underway, due to improved economics, tighter water supplies and tradeoffs between treating water supplies and recycling. Two major obstacles to the process of potable water from sewage are the high costs and the potential health hazards posed by reclaimed water. The potential market for operation and maintenance services in wastewater treatment plants is enormous with local governments spending more than $6 billion in 1984 for these functions at wastewater treatment plants. (Baker-IVI)
W85-04751

COMMERCIAL MINING TECHNIQUE OFFERS A NEW APPROACH TO REMOVING HEAVY METALS FROM SLUDGES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. G. Henry, and L. Wong.
Water and Pollution Control, Vol. 122, No. 3, p 56-57, May/June, 1984.

Descriptors: *Biological wastewater treatment, *Sludge treatment, *Heavy metals, *Bacterial leaching, Extraction, Bacteria, Wastewater treatment, Cadmium, Copper, Nickel, Zinc.

A biological process currently under study appears to have great potential for the reduction of heavy metal concentrations in sewage sludges. The process is defined as the dissolution of metals from insoluble minerals either directly by the metabolism of microorganisms or indirectly by the products of their metabolism. In the direct mechanism the leaching bacteria attack mineral sulfides directly by enzymatic cations. Because of the oxidation of mineral sulfides, metals will become solubilized. The principal microorganism associated with bacterial leaching is Thiobacilus ferrooxidans. Bacterial leaching has been used commercially in the mining of low grade copper and uranium ores. The fact that heavy metals exist in the reduced sulfide form in an aerobically digested sewage sludge suggested that bacterial leaching could be used to extract metals from the sludge. Very good metal extraction efficiencies can be achieved: Cd 86%, Cu 65%, Ni 78%, and Zn 87%. The most significant advantage of the method is that extraction can be achieved at a much lower cost than other existing methods. (Baker-IVI)
W85-04767

CONTROLLING SEWAGE TREATMENT PLANT ODOURS,
London Pollution Control Div. (Ontario).
R. A. Wheeler.
Water and Pollution Control, Vol. 122, No. 5, p 22-23, 36, October, 1984. 1 Fig.

Descriptors: *Odor control, *Wastewater treatment, *Potassium permanganate, *Oxidants, Oxidation, Hydrogen sulfide, Belt presses.

The city of London, Ontario has five treatment plants with a design capacity of almost 42.3 million gallons per day. At the Greenway plant, which operates as the pollution control center, belt presses were used to replace vacuum filters. Using the belt presses enabled much of the hydrogen sulfide gas produced to escape into the atmosphere both in and outside the plant. Use of hydrogen peroxide to transform H2S into elemental sulfur or soluble sulfates presented difficulties in handling and length of time needed for the reaction to occur. Potassium permanganate was tried as an alternative oxidant. As a result of positive tests, a feeder was installed to feed potassium permanganate into the sludge. Not only were health objectives met, but an increase in throughput was noted along with a reduction in chemical costs and maintenance reduction. (Baker-IVI)
W85-04769

SEWAGE PLANT PROVIDES ENERGY FOR DISTRICT HEATING SYSTEM,
Triton, Washington, DC.
R. J. Willcocks.
Water and Pollution Control, Vol. 12, No. 5, p 24-25, September/October, 1984. 1 Fig.

Descriptors: *Wastewater treatment, *Sludge treatment, *Waste heat, *Energy conservation, Heating.

Operations staff at a sewage treatment plant have been experimenting with the two stage anaerobic digesters to optimize the process. Significant increases in the production of digester gas have resulted, leading to the possibility that the plant will be expanded and the captured heat produced by the engine generator will be used to heat the raw sludge, digester and filter buildings and a nearby school. By improving the digester design, the existing digester volume will be used better, thus postponing or possibly eliminating the need for large digesters in the expanded plant. Utilization of surplus gas from 1978 to 1980 represented savings in excess of $10,000 per year in natural gas and represented one half of the available surplus. At present the remainder is being flared. (Baker-IVI)
W85-04770

FLOW BALANCING SYSTEM FOR STORM-WATER AND COMBINED SEWER OVERFLOW,
P. H. Stevers.
Water and Pollution Control, Vol. 122, No. 6, p 14, 17-18, December, 1984. 2 Fig.

Descriptors: *Combined sewer overflows, *Flow regulators, *Storm runoff, *Flow balancing method, Overflow, Urban runoff, Flood peak, Plug flow.

Environmental problems caused by urban runoff and combined sewer overflow are becoming increasingly serious. There are many technical solutions to the problem of flow equalization such as artificial ponds, mechanical retaining devices within the pipes and culverts, and concrete tanks. A flow balancing method (FBM) is described which operates on the principle of plug flow and consists of a series of cells in a water body constructed by suspending reinforced plastic curtains from floating pontoons. When the influent water flow rate exceeds the pumping rate to the treatment plant, the excess water begins to displace the lake water in the adjacent cell. This displacement process will eventually fill all the cells with polluted water if the influent rate remains greater than the pumping rate. The reverse occurs when the pumping rate exceeds the influent flow rate. This causes the lake water to reenter the FBM in the last cell and displace the polluted water. Once all of the polluted water has been displaced by the lake water, the FBM is ready for another surge in the influent flow rate. The FBM can be used as a settling basin and is a low cost alternative to conventional balancing systems. The main reason for the cost advantage is that the FBM is situated in the recipient water body so little or no land is required. It is also very energy efficient since the pressure head required to pump water back to a treatment facility is very low. (Baker-IVI)
W85-04772

MAIN RESULTS OF A PROJECT FOR ARTIFICIAL GROUND-WATER RECHARGE FROM SECONDARILY TREATED SEWAGE IN THE MUNICIPAL FOREST OF THE CITY OF LANGEN (LOWER MAIN REGION) (DIE WICHTIGSTEN ERGEBNISSE EINES PROJEKTES ZUR KUNSTLICHEN GRUNDWASSER-ANREICHERUNG MIT WEITERGEHEND BEHANDELTEM ABWASSER IM LANGENER STADTWALD (UNTERMAINREGION)),
Hessische Landesanstalt fuer Umwelt, Wiesbaden (Germany, F.R.).
B. Toussaint.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 4, p 107-117, October, 1984. 12 Fig, 1 Tab, 12 Ref.

Descriptors: *Artificial recharge, *Effluents, *Groundwater pollution, Groundwater recharge, Langen, Germany (Federal Republic), Nitrates, Organic carbon, Water pollution control, Water quality.

During the years 1980-1982 about 514,600 cu m biologically posttreated sewage effluents were made to infiltrate into a Quaternary porous aquifer of 30 m thickness in the Langen municipal forest. Two thirds of the infiltrate, which could be identified for a distance of about 300 m in the underground, became efficient for storage. The extracted ground water showed heavy anthropogenic contamination; the purification capacity of the underground has proved to be not at all as efficient as supposed in general. Although the secondarily treated sewage water fulfilled, except for its high nitrate content, the requirements for drinking-water quality according to the current regulations, the level of unregulated dissolved organic carbon (which may contain hidden organic pollutants) was found to be high. Therefore, it is advised to dispense with further recharge measures. Instead, it is necessary to intensify the preventive ground-water protection. (Author's abstract)
W85-04809

NEED FOR CHEMICAL PHOSPHATE REMOVAL,
Directorate of Water Affairs, Johannesburg (South Africa).
H. J. Best.
Water, Sewage and Effluent (Johannesburg), Vol. 9, p 21-23, 1982. 2 Tab, 8 Ref.

Descriptors: *South Africa, *Phosphorus removal, *Wastewater treatment, Eutrophication, Biological treatment, Water quality standards.

In South Africa, rapid development in the catchments of the major rivers with a corresponding increase in the nutrient loads draining into these rivers, has caused the presence of algae and aquatic weeds in streams and impoundments to become almost a national phenomenon. While fully eutrophic impoundments are still relatively few in number, treatment difficulties are also experienced with waters from sources generally considered to be mesotrophic and oligotrophic. Adverse effects of enrichment include increased purification costs for water; increased level of training and expertise required by water treatment operators; clogging of pump intakes; losses of livestock from toxins produced by certain algal strains; and loss in recreational value of lake surfaces. The main sources of phosphates in South African impoundments are point discharges of sewage effluents and runoff from agricultural lands and urban areas. Biological removal of nutrients from biological filter plants seems to be only feasible with the addition of external carbon sources. In the case of existing and minor activated sludge plants within the sensitive areas and where modification to biological nutrient removal status cannot be economically justified, chemical precipitation is the only viable solution to meet the phosphate standards. (Baker-IVI)
W85-04821

SOME ASPECTS OF THE USE OF OXIDATION TECHNIQUES IN THE TREATMENT OF SEWAGE,
D. Hebden.
Water, Sewage and Effluent (Johannesburg), Vol. 9, p 57-67, 1982. 4 Fig, 1 Tab.

Descriptors: *Wastewater treatment, *Oxidation, *Municipal wastewater, Biological wastewater treatment, Activated sludge process, Oxidation ponds, Tricking filters, Suspended solids, Total organic carbon, Aeration, Disinfection, Chlorine.

Primary solids removal is used where the wastewater contains a high enough concentration of large, dense suspended or settleable solids to make removal economical. Biological treatment can be accomplished in a number of ways, but the basic characteristics of the system is the use of mixed bacterial cultures for the conversion of pollutants. In most cases, organic materials are converted to oxidized end products, mostly carbon dioxide and new bacterial cells. Biological processes are most commonly used for secondary treatment, conversion of organics remaining after a primary sedimentation process is applied to remove suspended solids. Two configurations are in common use: film flow and suspended. Suspended culture processes in use include activated sludge, aerated lagoons, oxidation ponds, and anaerobic treatment processes. Other biological processes of current importance include lagoons, anaerobic digesters and nitrogen conversion systems. Most biological treatment processes have the primary purpose of removing organic material from a wastewater. The importance of inorganic nutrients and suspended solids is considered. Discussion also centers around the activated sludge process, hydraulic residence time, extended aeration processes, pure oxygen activated sludge systems, aerated lagoons, oxidation lagoons, maximum oxygen

transfer rates, disinfection, desirable properties of disinfectants, chlorine, and the rate of disinfection with chlorine and the advantages and disadvantages of using chlorine as a disinfectant. (Baker-IVI)
W85-04822

EFFECTS OF DECHLORINATED SEAWATER ON FISH BEHAVIOR,
Occidental Coll., Los Angeles, CA. Dept. of Biology.
J. E. Hose, T. D. King, and J. S. Stephens, Jr.
Marine Environmental Research, Vol. 11, No. 1, p 67-76, 1984. 2 Tab, 30 Ref. Southern California Edison contract C0650901.

Descriptors: *Dechlorination, *Fish behavior, *Seawater, Wastewater treatment, Chlorination, Opaleye, Goby, Oxidants, Toxicity, Avoidance, Halogenated hydrocarbons, Effluents.

Dechlorination of water has been proposed as a method of removing the toxicity of chlorinated industrial and municipal effluents. Behavioral responses of motile marine organisms such as fish to effluent-borne pollutants may modify actual toxicant exposures. Behavioral responses to chemically dechlorinated seawater were studied using two species of marine fish associated with power plant discharge areas off Southern California. Opaleye (Girella nigricans) neither avoided nor were attracted to chlorinated seawater containing 0.1 mg/liter total residual oxidants (TRO) which had been dechlorinated using equimolar or excess sodium thiosulfate. Blue-banded goby (Lythrypnus dalli) did not avoid dechlorinated seawater initially containing 0.1 or 0.9-1.0 mg/liter TRO. Elimination of chlorine-produced oxidants by thiosulfate dechlorination resulted in 100% survival in both species. Exposure of fish to organohalogen byproducts formed during chlorination would theoretically be minimized by avoidance of chlorinated effluent when compared with exposure to a dechlorinated effluent containing a similar level of halogenated organics and which is not avoided by fish. (Moore-IVI)
W85-04862

ANAEROBIC TREATMENT OF CONCENTRATED INDUSTRIAL WASTEWATER,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Chemical and Biochemical Engineering.
P. Corbo, and R. C. Ahlert.
Environmental Progress, Vol. 4, No. 1, p 22-26, February, 1985. 9 Fig, 2 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Anaerobic digestion, Methane, Digestion, Anaerobic conditions, Industrial wastes, Leachates, Landfills, Organic compounds, Fatty acids.

Test results are given for anaerobic digestion with the production of methane as a possible treatment for industrial landfill leachate. The study of volatile fatty acids during batch experiments provides several insights into the degradation of organic solutes in the complex wastewater used. A one tenth dilution of leachate led to a very slight lag period for the removal of acetate, propionate, and butyrate, with an unadapted culture of selected organisms. Leachate components do not affect the bacterial culture adversely, at a fairly high concentration. The buildup of conservative or nondegradable compounds could affect the bacteria in a continuous process. An overall dissolved organic carbon reduction of 61% was noted during a batch experiment using a leachate dilution of five per cent and a culture adapted to leachate. The build up of butyrate indicates a breakdown of other, larger organic species in the leachate. When a culture selected for volatile fatty acid degradation was used, this effect was not observed. Apparently the organisms responsible for the formation of butyrate from higher compounds are not present in this culture. Inhibition of methane occurs when the leachate adapted culture is dosed with leachate, presumably because of sulfate reducers. This problem can be eliminated by removing the sulfuric acid step from the pretreatment scheme or selecting a culture from a seed that does not contain sulfate reducers. (Baker-IVI)
W85-04877

FATE OF CONTAMINANTS DURING TREATMENT OF H-COAL PROCESS WASTEWATERS,
Department of Energy, Pittsburgh, PA. Pittsburgh Energy Technology Center.
C. J. Drummond, R. P. Noceti, R. D. Miller, T. J. Feeley, III, and J. A. Cook.
Environmental Progress, Vol. 4, No. 1, p 26-33, February, 1985. 3 Fig, 7 Tab, 8 Ref.

Descriptors: *Coal liquifaction, *Industrial wastewaters, *Wastewater treament, Coal gasification, Ammonia, Cyanide, Hydrogen sulfide, Phenol, Organic compounds.

The treatment train investigated is capable of significantly improving the quality of H-Coal liquifaction process wastewater, reducing contaminant concentrations to low levels. The detailed characterization of the effluents from each of the unit operations in the treatment sequence allows a determination of the degree of treatment required for specific applications for reuse in the facility or for discharge to the environment. The observed aquatic toxicity of the wastewater was drastically decreased over the treatment train employed indicating that any contaminants remaining in the wastewater do not contribute significantly to its aquatic toxicity. Measurements of the constituents in the sludges formed during treatment indicate that certain elements could accumulate in the lime sludge and the bio-sludge, requiring proper disposal. (Baker-IVI)
W85-04878

GASIFIER WASTEWATER TREATMENT: PHASE I COOLING TOWER ASSESSMENT,
North Dakota Univ., Grand Forks. Energy Research Center.
M. D. Mann, W. G. Willson, and J. G. Hendrikson.
Environmental Progress, Vol. 4, No. 1, p 33-39, February, 1985. 4 Fig, 7 Tab, 11 Ref.

Descriptors: *Wastewater treatment, *Cooling water, *Coal gasification, Stripped gas liquor, Water reuse, Wastewater renovation, Makeup water, Biofouling, Corrosion.

The effectiveness of using minimally treated wastewater as makeup to a cooling tower was investigated. Ammonia, alkalinity, phenol, and other non-hydantoin organics were removed from the cooling water by stripping and/or biological degradation with the phenol concentration in the exhaust air exceeding the odor threshold. Foaming of the circulating water will be a problem using stripped gas liquor (SGL) as makeup, and foaming control will be needed. Both glycol and silicon based agents were used successfully to control foaming during the test. The SGL feed cooling system supported a high level of biological activity, predominantly Pseudomonas aeruginosa. This high level led to severe biofouling of all carbon steel surfaces. Biofouling control will be a key factor in maintaining clean heat transfer surfaces in an industrial system using similar wastewater. General corrosion rates of 12.5 to 24 mils/year were measured for carbon steel in various parts of the system. Corrosion rates increased with increasing temperature and velocity. Carbon steel will not provide an adequate service life if used as thin walled heat exchanger tubing without the use of corrosion inhibitors and biocides. Both 304L and 316 stainless steel heat exchanger tubes showed no significant metal loss from either general or pitting corrosion. Hydration of Type V concrete occurred after exposures to the SGL cooling water, resulting in increased friability and loosening of the bonding between the concrete and the aggregate. The use of SRG similar to that produced by the UNDERC pilot gasifier as cooling tower makeup water is limited by a number of potentially serious operating problems. This water could be used for cooling tower makeup only after additional treatment or possibly with the use of biocides, corrosion inhibitors and other control methods. (Baker-IVI)
W85-04879

WASTEWATER TREATMENT SYSTEMS FOR SYNTHETIC FUELS PLANTS BASED ON PEAT AND OIL SHALE,
I. Frankel, and M. Drabkin.
Environmental Progress, Vol. 4, No. 1, p 39-43, February, 1985. 8 Fig, 4 Tab, 2 Ref.

Descriptors: *Wastewater treatment, *Synthetic fuels, *Oil shale, *Peat, Industrial wastes, Mine wastes, Water reuse.

Wastewater treatment systems being used or proposed for use in synthetic fuel projects which were based on peat and oil shale are reviewed. The wastewater technologies used are functions of three major factors: nature of the fossil fuel raw material, nature of the fuel conversion process, and site-specific considerations such as zero discharge of wastewater. At Northern Peat Energy a combined anaerobic aerobic process is proposed for wastewater treatment. At the Peat Methanol Associates Peat Gasification Project the basic approach to wastewater treatment is to treat process and non-process wastewater separately, followed by discharge of the combined treated effluent to surface waters under an NPDES permit. At Seep Ridge water and oil are separated in a heater/treater unit followed by an API separator for the oily water which is then steam stripped for removal of ammonia and other gases, combined with lesser quantities of wastewater from other sources, and pumped with water treatment chemicals into the KTI Thermosludge boiler. At the Paraho-Ute Project the oil shale project is based on zero discharge with reuse of all wastewaters, principally for spent shale moisturization. At Cathedral Bluffs, the principal source of input water into the treatment system is the mine water. The Union Oil Parachute oil shale project will feature zero discharge of wastewaters. All wastewaters will be used in cooling and wetting the retorted shale prior to placement on a spent shale pile in the valley of the East Fork Parachute Creek. (Baker-IVI)
W85-04880

OXIDATION OF CYANIDES IN INDUSTRIAL WASTEWATERS BY OZONE,
Drexel Univ., Philadelphia, PA. Dept. of Environmental Engineering.
M. D. Gurol, W. M. Bremen, and T. E. Holden.
Environmental Progress, Vol. 4, No. 1, p 46-51, February, 1985. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Wastewater treatment, *Ozonation, *Oxidation, *Cyanides, Industrial wastes, Kinetics, Cyanates, Copper.

Various industrial processes such as metal finishing, photographic bleaching, and iron and steel manufacturing produce substantial amounts of wastewater which may contain free cyanide and metal complexes of cyanide. Ozone is an alternative process for the oxidation of cyanide. In the absence of any metals, ozone reacts primarily with the cyanide ion with a very fast rate; its reaction with hydrogen cyanide is negligible. The reaction is first order with respect to ozone and fractional order with respect to cyanide ion. This fractional order is an indication that the reaction is not a simple, bimolecular elementary reaction, but involves the formation and reaction of free radicals. Upon oxidation of each mole of cyanide, one mole of ozone is consumed, and one mole of cyanate is produced as the intermediate product of the reaction. Oxidation of cyanate by ozone is a slow reaction; therefore, cyanate accumulates in the solution until cyanide is oxidized completely. The oxidation of cyanide at high pH is expected to be mass-transfer limited under the operating condition of most experimental and full-scale ozone contactors. The kinetic regime for operations at neutral pH should depend upon the mass-transfer characteristics of the ozone contactors as well as the concentration of cyanide in water. The presence of copper causes a significant increase in the oxidation rate of cyanide, but does not affect the stoichiometric relations. The mechanism of copper-catalysis involves an oxidation-reduction reaction between Cu(II) and cyanide ion. The complexation of cyanide with iron hinders the oxidation of cya-

nide significantly. Cyanate is not detected as an intermediate product. (Baker-IVI)
W85-04881

STUDY OF DOMESTIC SEWAGE WASTE TREATMENT BY THE POLYCHAETES, NEANTHES JAPONICA AND PERINEREIS NUNTIA VAR. VALLATA, ON AN ARTIFICIAL TIDAL FLAT,
Tohoku Univ., Sendai (Japan). Biological Inst.
Y. Kurihara.
Internationale Revue der Gesamten Hydrobiologie, Vol. 68, No. 5, p 649-670, 1983. 10 Fig, 11 Tab, 17 Ref.

Descriptors: *Biological wastewater treatment, *Polychaetes, *Tidal flats, Pilot plants, Activated sludge, Chlorinity, Water temperature, Wastewater treatment.

A new biological method of treating sewage waste, mass cultures of the polychaete annelids Neanthes japonica and Perinereis nuntia var. vallata, is being developed. The effects of environmental factors on the food consumption, survival and growth of the polychaetes were studies in continuous culture systems in the laboratory. Both species could ingest large quantities of activated sludge discharged from sewage treatment plants and egest about half of the sludge as fecal pellets. The maximum daily sludge consumption by adult N. japonica ranged from 500 to 1000 mg/100 sq cm of sand area at 10 0/00 chlorinity and 20 C water temperature. The conditions under which P. nuntia consumed sludge most rapidly included a chloride concentration from 10 0/00 to 20 0/00, a water temperature between 20 and 30 C, and a substrate consisting of sand and gravel, exposed periodically. With these conditions, it is expected that P. nuntia could ingest sewage sludge at a rate of about 150 to 300 mg/100 sq m of sand bed daily. A pilot plant with an artificial brackish lagoon, consisting of an aeration tank and a sand tank in which a large number of N. japonica were kept, was constructed and operated for 7 months. When effluent from the aeration tank containing domestic sewage diluted with seawater was conducted to the sand tank, the effluent filtered through the sand bed had excellent transparency and reduced COD. A pilot plant for an artificial lagoon, which consisted of a seawater tank and a worm tank where P. nuntia were kept, was operated for one year. The worms could propagate themselves for several generations and developed normally in the worm tank. The daily ingestion rate was estimated to be about 60 mg sludge/100 sq cm of sand bed. (Moore-IVI)
W85-04903

CONTROL AND TREATMENT TECHNOLOGY FOR THE METAL FINISHING INDUSTRY. IN-PLANT CHANGES.
Industrial Environmental Research Lab.-Cincinnati, OH.
Report EPA 625/8-82-008, Summary Report, January 1982. 30 p, 10 Fig, 10 Tab, 15 Ref.

Descriptors: *Industrial wastes, *Cost analysis, *Wash water, *Wastewater treatment, *Industrial wastewater, *Waste recovery, *Metal-finishing wastes, Cost-benefit analysis, Regulations, Wastewater disposal, Wastewater, Recycling, Wastewater pollution, Wastewater management, Case studies, Wastewater renovation.

This report describes the first steps an electroplating plant should take to comply with either the U.S. EPA wastewater treatment and disposal guidelines or Resource Conservation and Recovery Act regulations. Drag-out of process solutions and contamination of rinse waters may be reduced by controlling the viscosity of plating solutions. Wetting agents will reduce drag-out loss by as much as 50%. Positioning of the workpieces on the rack, the workpiece withdrawal and maintenance and design of racks and barrels can all affect the drag-out. The recovery of plating bath chemicals by a grain board, drip tank, fog rinsing or a drag-out tank is recommended. Rinse water recycling or the use of multiple rinse tanks can reduce the amount of water use and water treatment costs. Cost evaluations for rinsing recovery schemes for Ni, Cr and cyanide Zn plating systems are given. Procedures and a case study for the initial plant assessment to reduce plating industry pollution are outlined.
W85-04929

CONTROL AND TREATMENT TECHNOLOGY FOR THE METAL FINISHING INDUSTRY. ION EXCHANGE.
Industrial Environmental Research Lab.-Cincinnati, OH.
Report EPA 625/8-81-007, Summary Report, June 1981. 46 p, 26 Fig, 22 Tab, 19 Ref.

Descriptors: *Ion exchange, *Metal-finishing wastes, *Industrial wastes, *Wastewater treatment, *Recycling, *Industrial wastewater, *Separation techniques, *Cost analysis, Wastewater renovation, Waste recovery, Wastewater management, Anion exchange, Cation exchange, Metals, Heavy metals, Performance evaluation, Wash water, Water reuse.

Ion exchange process theory is reviewed and evaluated in three major areas of application in the metal finishing industry in terms of performance, state of development, cost, and operating reliability. Application of the ion exchange process in a wastewater purification and recycle system will significantly reduce water consumption and the volume of wastewater discharged. Ion exchanged can be used in two different forms for end-of-pipe pollution control; it can polish the effluent from conventional hydroxide precipitation to lower the metal concentration in the discharge, and it can treat wastewaters directly to remove heavy metal and metal cyanide pollutants. In general, ion exchange systems are suitable for chemical recovery applications where the rinse water feed has a relatively dilute concentration of plating chemicals and a relatively low degree of concentration is required for recycle of the concentrate. Ion exchange is well suited for processing corrosive solutions and has been used commercially for recovery of plating chemicals from acid-Cu, acid-Zn, Ni, Sn, Co, and Cr plating baths. Ion exchange has also been used to recover spent acid solutions and to purify plating solutions for longer service life.
W85-04931

BASIC TECHNOLOGY OF THE PULP AND PAPER INDUSTRY AND ITS ENVIRONMENTAL PROTECTION PRACTICES,
Environmental Protection Service, Ottawa (Ontario).
N. McCubbin.
Available from EPS, Environment Canada, Ottawa K1A 1C8, Ontario. Environmental Protection Programs Directorate Training Manual EPS 6-EP-83-1, October 1983. 204 p, 54 Fig, 26 Tab, 28 Ref.

Descriptors: Pulp and paper industry, *Reviews, *Canada, *Pulp wastes, *Wastewater treatment, *Waste disposal, Pulp washing, Environmental protection, Water pollution control, Industrial wastes, Kraft mills, Sulfite liquors, White water, Primary wastewater treatment, Solid wastes, Costs, Tertiary wastewater treatment, Effluents.

The technology of pulp and paper manufacture in Canada is described with particular focus on environmental protection. Pretreatment of mill effluents includes removal of grit, coarse material and debris, neutralization of acid or alkaline wastes, and directing occasional large flows or concentrated streams to spill tanks or basins. Primary effluent treatment processes reduce the biodegradable portion of the dissolved organic constituents. Tertiary treatment of organic constituents also takes place. Tertiary treatment also removes color, odor, taste, toxins, dissolved chemicals and gases, residual suspended solids and biodegradable material. Most mills employ internal sampling and monitoring of effluents in addition to those specified in Pulp and Paper Effluent Regulations. Total effluent treatment costs (primary and secondary) in 1982 for baled pulp, linerboard, newsprint produced through the groundwood sulfite process and newsprint produced through the TMP process were 16 million, 10 million, 20 million, and 12 million dollars, respectively. Disposal of solid wastes must be in accord with regulatory requirements. The sources and control of atmospheric emissions in the pulp and paper mill are also discussed.
W85-04932

STATUS REPORT ON ABATEMENT OF WATER POLLUTION FROM THE CANADIAN PETROLEUM REFINING INDUSTRY - 1980.
Environmental Protection Service, Ottawa (Ontario).
Economic and Technical Review Report No. EPS 3-WP-83-3, March 1983. 35 p, 6 Fig, 10 Tab, 3 Ref, 2 Append.

Descriptors: *Wastewater treatment, *Oil industry, *Regulations, *Oil wastes, *Water pollution control, Canada, Waste disposal, Waste management, Oil, Wastewater disposal, Industrial wastes, Oil refineries, Oil pollution.

This report assesses the state of compliance in 1980 of the Canadian petroleum refining industry with effluent regulations and guidelines to limit pollutant discharges under the Federal Fisheries Act of 1973. Of the 36 operating refineries in Canada at the end of 1980, one had no discharge during the year, five were in compliance 100% of the time, 17 exceeded the discharge limits up to 5% of the time, and 13 exceeded the limits more than 5% of the time. Among the latter 13 refineries, four had treatment provided off-site, and three were treating wastewaters which may be classified as petrochemical effluents with their refinery effluents. The problems encountered in the last six refineries were due to operating difficulties or lack of appropriate treatment facilities. A number of these facilities have undertaken corrective measures. Of all test results required by the regulations and guidelines, 32% were not reported due to discrepancies and deficiencies in municipal and federal requirements and in interpreting guidelines. These problems are being addressed and analytical procedures described in the regulations and guidelines are being updated. A number of Canadian agencies are characterizing refinery effluents for trace organic compounds and determining the fate of these treatment systems.
W85-04940

EFFECTS OF A TEXTILE FACTORY EFFLUENT ON SOIL AND CROP PLANTS,
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, and A. U. Khan.
Environmental Pollution (Series A), Vol. 37, No. 2, p 131-148, 1985. 7 Tab, 33 Ref.

Descriptors: *Textile mill wastes, *Plant growth, *Soil chemistry, Sodium, Potassium, Calcium, Magnesium, Sodium, Water pollution effects, Wastewater irrigation.

Effluent from a textile factory was characterized and its effect observed at various concentrations (25, 50, 75, and 10%) on soil chemical properties, seed germination and growth of two plants. The effluent was highly alkaline, had considerable amounts of ammonia-N, total P, chlorides, sulfates, Na, Ca and Mg. In the soil, the greatest change caused by the application of the effluent was an increase the organic matter content followed by ammonia-N, K, Na, P, Ca and Mg. Pot soils supporting kidney bean and lady finger (Abelmoschus esculentus) plants irrigated with various effluent concentrations were also analyzed. The concentrations of water soluble salts and other nutrients were lower in the soils supporting these plants compared to soils without plants irrigated with effluent. A gradual increase in the sodium content of both plants was noted with increasing effluent concentrations, the highest values being found in plants grown with undiluted effluent. The concentrations of K, Ca and Mg were highest in the fast growing plants. Seeds sown in soils treated with 100% effluent took the longest time for germination followed by the 75% treatment, whereas no delay was noted in germination with other effluent concentrations. The shoot length, root length, size of leaves, number of leaves and dry weight of

plants for both the crops were maximum in 50% effluent irrigated pot soils followed by 25, 75, and 100% as compared to control. (Baker-IVI)
W85-04945

PURE O2 RETROFIT DOUBLES PLANT'S CAPACITY,
Wiedeman and Singleton, Inc., Atlanta, GA.
K. Duchon, and S. Buchanan.
Water Engineering and Management, Vol. 132, No. 2, p 22-24, February, 1985. 5 Fig, 3 Tab.

Descriptors: *Wastewater treatment, *Oxygen, Water pollution control, Wastewater treatment facilities, Oxygen diffusion system, Clarifiers.

Mounting problems at the Boar Tusk Creek Wastewater Treatment Plant in Conyers, Georgia were centered mainly on the need to expand capacity, seemingly without the space to meet that need. A year long upgrade project included the installation of a new oxygen diffusion system. The plant had been operating at a level 50% over its 500,000 gpd design capacity. The 20 year old plant yielded an effluent quality that was consistently 50 mg/l BOD5 and 125 mg/l TSS, both far in excess of contemporary standards. To upgrade the plant required less than a year and most of that time was taken up by construction of two additional final clarifiers and other work, including modifications to the sludge-handling equipment and general plant repairs. (Baker-IVI)
W85-04953

DISPERSION MODEL FOR WASTE STABILIZATION PONDS,
Asian Inst. of Tech., Bangkok (Thailand).
C. Polprasert, and K. K. Bhattarai.
Journal of Environmental Engineering, Vol. 111, No. 1, p 45-59, February, 1985. 5 Fig, 2 Tab, 31 Ref, 1 Append.

Descriptors: *Wastewater treatment, *Stabilization ponds, *Dispersion, Model studies, Mathematical equations, Hydraulic detention time, Kinematic viscosity, Design criteria.

The phenomena occurring in waste stabilization ponds are complex, consisting of the biochemical reaction of algal-bacterial symbiosis and hydraulic flow treatment processes. To be accurate in design and to obtain reliable results, pond design should be based on the respective reactions and processes occurring in them. The partially-mixed or dispersed-flow equation is proposed for use in pond design for organic and bacterial reductions. This equation considers the effects of hydraulic detention time, reaction rate coefficients, and the dispersion factor including short-circuiting, and other hydraulic transport processes which influence the pond's performance. A dispersion prediction formula for ponds is proposed which relates the pond's dispersion factor to the hydraulic detention time, kinematic viscosity, and the pond's geometric shape, i.e., length, width, and depth. The formula and constants proposed should be considered only tentative; they need to be tested with more pond data, including variations in flows, inlet and outlet devices, and wind conditions. A design engineer should first become familiar with the local conditions and situations, before proceeding to design a pond system in that particular location. Field observations of existing or similar ponds, together with experience in pond design, greatly helps in designing an effective and economic pond system. (Moore-IVI)
W85-04966

NITROGENOUS WASTEWATER TREATMENT BY ACTIVATED ALGAE,
Indian Inst. of Tech., Bombay. Dept. of Chemistry.
S. K. Gupta.
Journal of Environmental Engineering, Vol. 111, No. 1, p 61-77, February, 1985. 8 Fig, 3 Tab, 23 Ref, 1 Append.

Descriptors: *Biological wastewater treatment, *Activated algae, *Nitrogen, Wastewater treatment, Bacteria, Algae, Nitrification, Alkalinity, Ammonia, Urea, Industrial wastewater, Fertilizers.

The wastewaters from the nitrogenous fertilizer industry containing a high concentration of ammonia and urea can be detrimental to the receiving bodies of water if discharged without treatment. Of the biological methods, the flocculating algal-bacterial system (activated algae) appears to be the most attractive process for the removal and conservation of nutrients from wastewater in a tropical country like India, where sunlight is available in plenty almost throughout the year. A bench scale biological treatability study by activated algae process was performed with synthetic wastewater containing about 700 mg/l of NH4(+)-N and 400 mg/l of urea. The wastewater could be processed at all nitrogen removal rates. The yield coefficient and decay coefficient for heterotrophic bacteria were 0.06 (COD basis) and 0.019/day (COD basis) respectively. The yield coefficient and decay coefficient for nitrifiers were 0.06 and 0.02/day respectively. NH4(+)-N seemed to inhibit bacteriological growth, as the yield coefficients values were significantly lower. Nitrification was observed at all the nitrogen loadings. Diffusion of NH3 into the atmosphere was the dominant mechanism of nitrogen removal. Recommended design criteria for activated algae treatment of nitrogenous wastewater are solids retention times of 10 to 40 days, hydraulic residence time of about 2-5 days, ammonia removal rates of 0.6/day to 1.8/day, COD removal rates of 0.5/day to 1.6/day, influent alkalinity of about 3,000 mg/l as CaCO3 and pH between 7.5 and 8.5. (Moore-IVI)
W85-04967

RESIDENCE TIME IN STORMWATER DETENTION BASINS,
Syracuse Univ., NY. Dept. of Civil Engineering.
S. J. Nix.
Journal of Environmental Engineering, Vol. 111, No. 1, p 95-100, February, 1985. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Detention reservoirs, *Storm runoff, *Residence time, Wastewater treatment, Mathematical equations, Steady flow, Storm wastewater, Simulation.

Stormwater detention basins act as pollution control devices because they provide time, residence time, for pollutants to settle or decay. The definition of residence time is volume divided by the flow rate which is theoretically applicable only when steady-state conditions prevail as in constant volume and flow rate. Potentially large discrepancies between the theoretical and steady state values of mean residence time are shown under the non-steady conditions found in stormwater detention basins. This occurs because the steady-state definition ignores previous events. The effect of the past, encompassed in the probability density function, is reduced as the inflow hydrographs become less dynamic and approach steady state. Consequently differences between the theoretical and steady state values become less pronounced. The simulation examined shows that a better estimate is obtained if the volume of water in the basin is divided by the average of the inflow and outflow rates. The steady state definition of residence time should be applied only with caution to stormwater detention basins. The steady-state definition is probably a poor indicator of the basin's pollution control capability. (Baker-IVI)
W85-04968

5E. Ultimate Disposal Of Wastes

SEWAGE SLUDGE TREATMENT AND DISPOSAL - THE WAY AHEAD,
T. Calcutt, and J. Moss.
Water Pollution Control, Vol. 83, No. 2, p 163-171, 1984. 2 Fig, 4 Tab.

Descriptors: *Sludge disposal, *Wastewater treatment, *United Kingdom, Ocean dumping, Land disposal, Economic aspects, Wastewater disposal.

The present situation regarding sewage treatment and disposal in the United Kingdom is reviewed. Budget cuts in the wastewater industry have necessitated a new look at the major concerns and issues. One relatively recent development the industry views with some apprehension is the increasing influence of the European Commission on sewage disposal practice through proposals aimed at introducing a degree of harmonization into environmental legislation over the Community. The anxiety centers around fears that these proposals could divert some of the limited financial resources available away from areas of higher priority. Disposal to sea has, for geographical reasons, developed to become an important element in the overall United Kingdom disposal strategy, whereas in other European Economic Community countries more extensive use is made of the landfill option. If sludge disposal at sea from vessels were to be restricted, attention could then be logically focused upon sewage disposal through pipelines. The major issue relating to the use of the sea for the treatment and disposal of waste products revolves around the level of environmental impact which is acceptable. There are two main areas where the wastewater disposal industry needs to focus attention over the next few years. There is a need to ensure that the substantial sums devoted to the treatment and disposal of sewage continue to be used to maximum effect and there is a need to ensure that future environmental policy has a sound scientific basis and provides good environmental value for money. (Baker-IVI)
W85-04455

PROBLEMS ASSOCIATED WITH THE DISPOSAL OF TRADE EFFUENT TO SEWERS - CHARGING AND CONTROL,
Severn-Trent Water Authority (England).
N. Harkness.
Water Pollution Control, Vol. 83, No. 3, p 367-375, 1984. 1 Tab, 17 Ref.

Descriptors: *Wastewater disposal, *Economic aspects, *Industrial wastes, Legislation, Water pollution control.

The opportunity to discharge trade (industrial) effluent to sewers was seen by the United Kingdom Royal Commission on Sewage Disposal at the beginning of the century as a means of reducing the severe effects of industrial effluent pollution by direct discharges to inland rivers. The trade effluent control and charging policies thus seem to be based on concepts formulated at least 70 years ago and on legislation introduced 46 years ago. At the same time, however, the administration of water services has undergone profound changes. Considering the relationship between trade effluent charging and control, charges may be a factor in influencing the loads of organic discharges or even volume of low strength trade effluent but cannot be used as an instrument for such purposes. Setting of trade effluent unit charges appears to be undertaken very much in the processes of setting outer water charges although the individual measurement of trade effluent strengths for charging purposes continues to be associated with control procedures. (Baker-IVI)
W85-04463

CHANGES IN THE EXTRACTABILITIES OF THE HEAVY METALS IN WATER-LOGGED SLUDGE-TREATED SOILS,
Oxford Univ. (England). Soil Science Lab.
P. H. T. Beckett, E. Warr, and P. Brindley.
Water Pollution Control, Vol. 82, No. 1, p 107-113, 1983. 3 Fig, 3 Tab, 17 Ref.

Descriptors: *Heavy metals, *Sludge disposal, *Land disposal, Zinc, Copper, Nickel, Lead, Anaerobic conditions, Saturated soils.

The interactions of three contrasting sludges from one treatment works with five contrasting soils were compared over 36 months under anaerobic conditions. The extractabilities of Cu, Ni and Zn in the sludge-treated soils were greater than the extractabilties of the native Cu, Ni, and Zn in soils alone, except for Zn in one soil whose high background level suggested that it was already contaminated. The extractabilities of Ni or Zn from sludge alone were greater than from mixtures of sludges and soils. The extractability of Cu from the

mixtures was comparable to that in sludge alone. Cu extractability increased with the duration of anaerobic storage in nearly every sludge, soil or sludge-soil mixture, except in mixtures with soil 6. Cu extractability tended to be greater in the slightly acid soils and lower in the more organic soils. Ni extractability in sludges alone increased with time and in two cases then fell. In sludge-soil mixtures it showed a very small but consistent decrease, either from the beginning or after a small initial rise. In sludges alone Zn extractability increased a little with time or remained constant. In sludge-soil mixtures it showed little change. For anaerobic conditions, heavy metals in contrasting sludges move towards similar forms of combination on prolonged interaction with soil, which is similar to what occurs under aerobic conditions. Thus it is reasonable to assume that one set of guidelines for disposal on to agricultural land will serve for all normal sludges. (Baker-IVI)
W85-04514

DESTRUCTION OF PATHOGENS AND PARASITES IN SEWAGE SLUDGE BY CHEMICAL MEANS,
North West Water Authority, Warrington (England).
A. F. Godfree, R. Bevins, and F. Jones.
Water Pollution Control, Vol. 82, No. 4, p 471-478, 1983. 3 Fig, 4 Tab, 9 Ref.

Descriptors: *Sludge conditioning, *Disinfectants, *Pathogenic bacteria, *Parasites, DF 955, Pathogens, Bacteria, Sludge disposal, Land disposal, Toxicity.

Laboratory and field trials were carried out with a formalin-based compound, DF 955, used to kill pathogens and parasites in sewage sludge. A contact period of not less than 1 hr was necessary to allow the desired kill of bacteria. There was little difference between the rates of kill with 1% or 1.5% DF 955. Field trials were conducted using a 1% (v/v) DF 955 concentration for a 1 hr contact period to determine any practical problems that may exist. No apparent problems were noted in the soil, earthworm population or the covering flora. Immediately following application the earthworm population did fall slightly, but the levels were quickly reestablished. The use of concentrations in excess of 1% resulted in greatly altered earthworm populations and the rapid scorching of all plant species. (Baker-IVI)
W85-04592

AVAILABILITY TO PLANTS OF PHOSPHATE IN SLUDGES PRECIPITATED FROM THE EFFLUENT FROM SEWAGE TREATMENT,
Oxford Univ. (England). Dept. of Agriculture.
M. Kuile, R. E. White, and P. H. T. Beckett.
Water Pollution Control, Vol. 82, No. 4, p 582-589, 1983. 31 Fig, 4 Tab, 16 Ref.

Descriptors: *Sludge disposal, *Phosphates, *Plants, Vegetation, Environmental effects, Iron, Aluminum, Calcium, Sludge drying, Anaerobic treatment, Wastewater treatment.

Batches of Fe-sludge, Al-sludge and lime sludge were prepared by flocculating the effluent from the secondary stage of sewage treatment with Fe2(SO4)3, Al2(SO4)3 and Ca(OH)2 at rates of 45, 40 and 100 mg/l of effluent, respectively. The fresh floc, containing 1-3% dissolved solids was subdivided for use as follows: fresh sludge applied immediately to the test soils; anaerobic sludge kept for 9-11 days in air tight polypropylene containers with glucose added to give a concentration of 5% in the lime sludge which was lower in organic content than the Fe- and Al-sludges; and dried sludge - air dried for 22 days. The three types of sludge were analyzed for organic matter, phosphate, iron and aluminium, calcium carbonate, and pH. When used fresh or after anaerobic storage for about 10 days, the sludges were ranked lime-sludge >> Al-sludge > Fe-sludge. Only the lime sludge showed promise as a P fertilizer. Using Ca(OH)2 as a precipitant also has the advantages of cheapness and producing a good floc. With the exception of Al-sludge on the ironstone soil, drying reduced the effectiveness of all three sludges to < 10% that of MCP. This was probably due to the formation of less soluble and more stable crystalline phosphates on drying and is a serious drawback to the use of these materials as fertilizers as they would have to be dried for ease of handling and transport. In general tertiary sludges would appear to be unsuitable substitutes for soluble P fertilizers under practical farming conditions. (Baker-IVI)
W85-04597

LET THE SEAS DO THE DISPOSAL,
Water Services, Redhill (England).
V. French.
Water Engineering and Management, Vol. 131, No. 13, p 22-24, December, 1984. 3 Fig, 2 Ref.

Descriptors: *Sludge disposal, *Outfalls, *Oceans, Planning, Design criteria, Tunnels, Pipelines, Fate of pollutants, Toxicity, Public health, Environmental effects.

A sludge disposal system should be achieved at the lowest cost without causing risk to public health, harm to living resources, damage to amenities, or restriction on normal activities. Several requirements should be met: no depletion of dissolved oxygen at the dumpsite; no smell that can be detected; rapid dispersion of discharge; no slick at the point of discharge; no settlement of solids on the seabed or the foreshore; and toxic levels that will not affect marine life. To determine the safety of a particular site, hydrodynamic characteristics must be firmly established. The design of the outfall should be such that the plume from one diffuser will not merge with that from its neighbor at any state of the tide. Problems peculiar to the outfall diffuser are the need to maintain a non-depositional or scour velocity in the mainpipe, and the wide range of flows that must be allowed for. In tunneled outfalls where the velocity is low, suspensions such as sand and silt tend to settle and the mixture of seawater and sewage can promote the growth of marine plants. Soil investigation of a possible sea outfall site is essential if disastrous consequences are to be avoided. (Baker-IVI)
W85-04648

THERMAL TREATMENT 'ENERGIZES' SAN MATEO SLUDGE,
Deutsche Akademie der Wissenschaften zu Berlin (German D.R.).
F. Cebalt.
Water Engineering and Management, Vol. 131, No. 13, p 25-27, December, 1984. 3 Fig, 1 Tab.

Descriptors: *Sludge treatment, *Sludge disposal, *Thermal treatment, Heat recovery, Conservation, Energy, Wastewater treatment.

A four year operating experience with a thermal process incorporating waste heat recovery has demonstrated that sludge is indeed a viable source of usable energy at a wastewater treatment plant. The wastewater treatment facility at San Mateo generates over 125,000 gpd of waste solids. Since this plant is hemmed in by heavily populated areas to the north, west, and south and by the Bay to the east, thermal treatment of sludge, followed by waste heat recovery, was incorporated in the design. Sludge is first thickened to 3-5% solids in a gravity thickener. Then it is thermally conditioned in the Zimpro low-pressure wet oxidation unit designed for a maximum throughput of 88 pgm. On two vacuum filters the conditioned sludge dewaters to a cake of 35-45% solids. Then it is fed to a 6 bed multiple hearth furnace. Heat is recovered from furnace off-gases in a waste heat recovery boiler where about 4,000,000 Btu per hr of steam is generated and reused as the heat source for the Simpro unit. Ash, 130 cu yards per month, is hauled to a landfill. Temperatures into the waste heat recovery boiler range from 1060-1325 F and from 550-650 F out of the boiler. (Baker-IVI)
W85-04649

WASTEWATER DISPOSAL AND UTILIZATION IN AGRICULTURE IN POLAND AND HUNGARY,
University of Agriculture, Godollo (Hungary).
L. Vermes, and J. Kutera.
Effluent and Water Treatment Journal, Vol. 24, No. 12, p 465-469, December, 1984. 1 Fig, 6 Tab, 15 Ref.

Descriptors: *Wastewater disposal, *Wastewater irrigation, *Poland, *Hungary, Land application, Water reuse, Agriculture, Wastewater treatment.

Soil-treating systems designed and operated with the necessary professional skill often produce removal efficiencies that are comparable to, or even better than, those attainable in any other type of sewage treatment system and at lower expenditures in energy and money. Case histories from Poland and Hungary are offered. At Wroclaw, Poland about 170,000 cu m of sewage are treated daily on 1050 ha of irrigated fields. The impact of sewage treatment has been evaluated by scientific centers, sanitary and water quality inspectors, based on analyses of the drain effluents, the groundwater below the drainage network, and on the water in drilled wells and the ditches collecting the seepage waters. The pollutants, both organic and mineral in nature, are removed at high efficiency. Sewage irrigation appears to present a realistic option to renew the ground water resources. In Gyula, Hungary, food industry wastewater combined with domestic sewage receive primary mechanical and partial biological treatment, and are then disposed of in the soil at the Gyula town sewage disposal plant, where around 7,000 cu m of sewage are handled daily. After short intermediate storage, the pretreated effluent is pumped through a buried delivery pipe to the ditch network of a poplar plantation where it percolates into the soil. The results of water quality analyses, hydrobiological and bacterial tests show that the sewage is treated efficiently, except for dissolved salts and, in some periods, the bacterial parameters. The system at Kecskemet, Hungary is more complex in that sewage from the town of around 80,000 inhabitants is used on plowed lands and disposed of either on a poplar plantation, or on a filter field. (Baker-IVI)
W85-04664

SEDIMENT DETENTION POND MODEL USING CSTRS MIXING THEORY,
Oklahoma State Univ., Stillwater. Dept. of Agricultural Engineering.
B. N. Wilson, and B. J. Barfield.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1339-1343, September-October, 1984. 9 Fig, 1 Tab, 4 Ref.

Descriptors: *Sedimentation, *Settling basins, *Sedimentation basins, *Model studies, Basins, Suspended solids, Plug flow models.

Current design techniques that are used to predict the performance of sedimentation ponds are based on plug flow models which do not allow for any mixing between inflow plugs and previously stored water. A detention pond model was developed based on the theory of continuous-flow stirred tank reactors in series (CSTRS). This model allows mixing between inflow plugs and previously stored fluid. Sediment deposition was calculated by conducting a mass balance in eight layers of pond depth. The model predicted the shape of the sedimentgraph quite well and overall the resonse of the sedimentation basin was simulated more accurately by the model than by a plug flow model. (Collier-IVI)
W85-04731

REVOLUTIONARY EXPERIMENTS TURN SLUDGE INTO FUEL,
S. Davey.
Water and Pollution Control, Vol. 122, No. 6, p 10-12, December, 1984. 3 Fig.

Descriptors: *Sludge utilization, *Oil, *Fuel, Sludge drying, Energy conservation.

In many urban cities sludge disposal is a serious problem, accounting for as much as 50% of the total wastewater treatment costs. Researchers have developed a process which converts sewage sludge into oil, having an energy value comparable to diesel fuel, char (a substance resembling lignite

coal) and noncondensible gases. If economically and technically viable at full scale, this process could have important ramifications for areas throughout the world where sludge disposal and energy shortages are serious problems. The process has been successfully demonstrated on both a batch and a continuous laboratory scale system and is said to be much simpler than other techniques. Sludge is first dried to 90-95% solids and then heated for up to thirty minutes in an oxygen-free environment, where it is transformed into oil, char, and noncondensible gases. The process works best with sludges that are contaminated with heavy metals. Researchers believe that catalyzed vapor phase reactions convert organics in the sludge to straight chain hydrocarbons, much like those present in crude oil. (Baker-IVI)
W85-04771

TOXICOLOGIC STUDIES ASSOCIATED WITH THE AGRICULTURAL USE OF MUNICIPAL SEWAGE SLUDGE AND HEALTH EFFECTS AMONG SEWAGE TREATMENT PLANT WORKERS,
New York State Coll. of Veterinary Medicine, Ithaca.
J. G. Babish, G. S. Stoewsand, J. M. S. Kranz, J. N. Boyd, and V. D. Ahrens.
Regulatory Toxicology and Pharmacoloy, Vol. 4, No. 3, p 305-321, September, 1984. 1 Tab, 69 Ref.

Descriptors: *Public health, *Sludge disposal, *Land disposal, Toxicity, Wastewater treatment, Groundwater pollution, Water pollution sources, Metals, Cadmium, Polychlorinated biphenyls, Organic compounds.

The proposed use of municipal sewage sludges as soil amendments on agricultural land involves potential health risks. Sludges may contain toxic heavy metals, synthetic organics, and pathogens. Studies of animals inhabiting sludge-amended soils, or foraging on crops grown on such soils, have shown an increased deposition of cadmium and polychlorinated biphenyls in animal tissues, hepatic microsomal enzyme induction, altered blood profiles, appearance of mutagens in blood and excreta, and lowered feed intake, feed efficiency and milk production. Epidemiological evidence of possible adverse health effects among sewage plant workers exposed to aerosolized pathogens or synthetic organic vapors during wastewater treatment or land spreading of sludge is still inconclusive. Other possible deleterious environmental effects include pollution of groundwater and toxicity to birds consuming worms or insects inhabiting sludge treated soils. A tabular summary of the toxicologic observations in animals (organisms) fed plants grown on sludge amended soils is presented. Current federal sludge management policy is reviewed. (Baker-IVI)
W85-04776

RECOVERY OF SPENT SULFURIC ACID FROM STEEL PICKLING OPERATIONS.
Environmental Research Center, Research Triangle Park, NC.
Technology Transfer Capsule Report. 25 p, 11 Fig, 5 Tab.

Descriptors: *Waste disposal, *Waste recovery, *Recycling, *Wastewater treatment, *Steel industry, *Sulfuric acid, *Cost analysis, Industrial wastes, Comparison studies, Wastewater disposal, Land disposal, Waste management, Wash water, Neutralization, Steel, Acids, Acidic water.

Methods of recovering sulfuric acid from spent pickle liquor are discussed with the aim of allowing small manufacturers to select the treatment technologies best suited for their facilities. Crystallization of Fe salts in pickle liquor can be induced by cooling or evaporating water from the solution. Added water occurs in the pickling process during steel rinsing, the injection of live steam to the pickling solution, and as a result of the reaction of Fe oxide scale with sulfuric acid. A dip and spray system can reduce rinse volume. At pickling capacities above 75,000 tons/yr, acid recovery may be the most economical choice unless a disposal problem exists. For capacities below 50,000 tons/yr, special site conditions will determine the most economical choice. Neutralization appears economical only where ample landfill space is available. Neutralization-oxidation systems offer the possibility for magnetite recovery, but are more expensive than neutralization alone. Iron loss from overpickling should be reduced to decrease investment and operating costs. At about 0.75% Fe loss, acid recovery systems and neutralization systems display about equal energy requirements with more favorable energy savings for acid recovery at higher Fe losses.
W85-04933

UNIFIED ANALYSIS OF THICKENING,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
D. E. Baskin, and M. T. Suidan.
Journal of Environmental Engineering, Vol. 111, No. 1, p 10-26, February, 1985. 13 Fig, 2 Tab, 15 Ref.

Descriptors: *Sludge thickening, *Model studies, Mathematical equations, Settling, Velocity, Sludge treatment, Wastewater treatment.

Two simplified models, originating from more complex existing models, were developed for easier analysis of thickener performance. Each relates zone settling velocity to solids concentraton. The first model applies thickener data to a log-log concept, while the second applies the data to a semilogarithmic mode. Further manipulation of the models resulted in nondimensional relationships between solids flux, underflow velocity and underflow solids concentration. When plotted on a log-log scale, the solution to the dimensionless logarithmic equation is described by a family of straight lines, each having a slope (1-n). A graph of the semilogarithmic model presents a single line. The operational lines represent a simple unified method that may be used to aid in the control of transient conditions as well as in the analysis of steady state behavior of sludge thickeners. (Baker-IVI)
W85-04964

5F. Water Treatment and Quality Alteration

SOME CHARACTERISTICS OF CHEMICAL CRYSTALLIZATION IN WATER PURIFICATION PROCESS,
Moscow State Univ. (USSR). Faculty of Chemistry.
I. V. Melikhov, Z. Vukovic, S. Bacic, and S. Lazic.
Chemical Engineering Science, Vol. 39, No. 12, p 1707-1713, 1984. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Water treatment, *Crystallization, *Chemical crystallization, *Chemical precipitation, Chemical reactions, Nucleation, Barium chloride, Sodium bicarbonate.

Coprecipitation of microimpurities with slightly soluble collectors is a widely used process in water purification. Crystallization was carried out at 298 K under conditions of rapid reagent solution mixing. 50 ml of 0.01 mol/l BaCl2 and Na2CO3 solutions were introduced by means of a mixer into an initially empty crystallizer in which the solution was continuously mixed by a stirrer. Samples were taken periodically and separated into phases by centrifugation; the solid phase was examined under an electron microscope. Crystallization proceeded by the formation of microcrystals which bind into aggregates and eventually take the form of psuedomonocrystals. The second phase of crystallization begins by formation of active centers of primary associate aggregation from four microcrystals. Oriented microcrystal binding with such centers occurs more often than in the course of microcrystal collisions so that centers grow by the mechanism of coagulation growth. The binding frequency practically does not depend on the primary aggregate and microcrystal size and the secondary aggregates in the course on transformation to pseudomonocrystals behave in an analogous fashion. These psuedomonocrystals do not differ by their outer properties from primary particles which have grown from separate crystallization centers exclusively on account of molecular growth. Actually, each pseudomonocrystal is formed from an average of ten primary microcrystals and represents a secondary form. The possibility of the appearance of secondary, regularly developed forms must be taken into account when interpreting chemical crystallization data. (Collier-IVI)
W85-04409

MAINTENANCE OF DRINKING WATER QUALITY: THE ESSENTIAL DECISIONS,
R. J. Kidson, and D. Morgan.
Water Pollution Control, Vol. 83, No. 1, p 23-30, 1984. 2 Fig, 3 Tab.

Descriptors: *Public health, *Bacteria, *Risks, *Drinking water, Water quality control, Assessments, Water treatment, Maintenance.

A conceptual framework is provided for the assessment of bacterial risk. Recommendations are offered on priorities in the management of water supply systems, including environmental surveillance. The danger of bacteriological contamination of public water supplies can be assessed by considering the underlying environment risks (the indirect risks). The potential hazards facing consumers relate not only to the indirect risks, but also to the bacterial purity of the drinking water (the direct risks). Both indices are useful in establishing the type of treatment required to adequately treat the water and in the case of existing sources, the priority of improvements necessary. Clear lines of communication should be defined for the transfer of significant information between scientific and operational departments, particularly when problems have been identified. A thorough and speedy response in dealing with any problems is of great importance. Levels of disinfection, repair of burst mains, regular maintenance of all treatment equipment and stocking of adequate spares are all essential to the safety of public supplies. Since risks to water can change with time, there is a need to consider environmental activities. It may be appropriate to carry out formal surveys from time to time. (Baker-IVI)
W85-04449

ENHANCE COOLING-WATER REUSE WITH SIDESTREAM SOFTENING,
K. F. Spear, and J. V. Matson.
Power, Vol. 128, No. 12, p 35-40, December, 1984. 5 Fig, 7 Ref.

Descriptors: *Water treatment, *Sidestream softening, *Cooling water, Blowdown, Scaling, Costs, Water softening, Water reuse, Makeup water, Computer models.

Sidestream softening can improve the efficiency of closed-cycle cooling and reduce requirements for blowdown and makeup water. The major application for sidestream treatment is to the high-hardness and/or high-silica waters. The medium- and low-hardness areas of the country also have potential application because of the recycling or concentrating of the makeup water by 20 to 50 times. This means that even a water with only 30-40 ppm total hardness would have a potential of 1500-2000 ppm hardness in the cooling tower, making it a prime candidate for sidestream treatment. Alternative treatments applicable to sidestream treatment include reverse osmosis, ion exchange, softening, and electrodialysis. The economics of sidestream softening are influenced by the cost of makeup water, makeup water quality, cooling-water-inhibitor program, and the effluent treatment costs. The raw water cost should be above 20-30 cents/1000 gal to warrant consideration of the technique. Water that is relatively high in hardness is a good candidate. The big dollar saving is usually in the cost of cooling-water-treatment chemicals. The blowdown contribution to the effluent is eliminated. Thus savings are incurred in operating costs or additional capacity availability. A computer model was developed to compare to economics of sidestream softening with a conventional cooling water system featuring blowdown. (Baker-IVI)

W85-04469

COMPARISON OF CURRENT METHODS OF POLIOVIRUS CONCENTRATION FROM TAP WATER,

Hadassah Medical School, Jerusalem (Israel). Environmental Health Lab.
N. Guttman-Bass, T. Hostovsky, M. Lugten, and R. Armon.

Water Research, Vol. 19, No. 1, p 85-88, 1985. 3 Tab, 17 Ref. EPA grants CR-806588-03-2 and CR 806416-01.

Descriptors: *Poliovirus, *Filtration, *Flocculation, *Viruses, Water treatment, Water analysis, Drinking water.

The efficiency of concentration of poliovirus from Jerusalem tap water was investigated for several types of 'electronegatively-charged' and 'electropositively-charged' microporous filters. In addition, the efficiency of organic flocculation as a procedure for reconcentrating poliovirus from filter eluates was investigated. The Balston and Cox filters had similar recovery efficiencies from tap water, with recovery of approx. 90% of the input virus, both after filtration and after organic flocculation. Decreasing the concentration of beef extract in the eluent from 3 to 1% did not negatively influence virus recovery. However, recovery of low virus numbers from large volume samples by Cox filters was variable. Balston filters were used in a series of high volume experiments to test the efficacy of the tentative standard method for virus recovery using a proportioner pump with two additive pumps. The method was inefficient without simple modification, the addition of a second mixing chamber, which increased the virus recovery to an acceptable level. The Zeta Plus electropositively-charged type of filter had a high efficiency of virus recovery in the eluate, but approximately half of the virus was lost during organic flocculation. This may indicate the need for modification of the organic flocculation method when used with filters. (Author's abstract)
W85-04492

COPRECIPITATION OF MICROALGAL BIOMASS WITH CALCIUM AND PHOSPHATE IONS,

Technion - Israel Inst. of Tech., Haifa. Environmental and Water Resources Engineering.
A. Sukenik, W. Schroder, J. Lauer, G. Shelef, and C. J. Soeder.

Water Research, Vol. 19, No. 1, p 127-129, 1985. 3 Fig, 9 Ref.

Descriptors: *Algae, *Calcium, *Phosphates, *Precipitation, Flocculation, Alkalinity, Hydrogen ion concentration.

Algal cultures which tended to flocculate under alkaline conditions were investigated in order to define the flocculating agent. Under the electron microscope, cells appeared to be agglomerated by inorganic 'amorphous' precipitates or rod shaped microcrystals. The use of an energy dispersive X-ray analyser showed that the agglomerating substance consisted of calcium and phosphorus and their atomic ratios varied between 1.07 and 1.34. The experiments suggest that in autoflocculation involving chemical coprecipitation with biomass, calcium phosphate constitutes the major binding agent. The Ca:P ratio in the precipitated calcium phosphate is greatly increased by raising alkaline conditions or increasing precipitation period. (Author's abstract)
W85-04498

STUDY OF WATERWORKS IN THE MANNHEIM/HEIDELBERG URBAN AREA USING THE EXAMPLE OF THE RHEINAU RHE WATERWORKS (WASSERWERKSBETRIEBE IM BALLUNGSRAUM MANNHEIM/HEIDELBERG AM BEISPIEL DES RHE-WASSERWERKES RHEINAU),

Rhein-Neckar Energy and Waterworks Corp., Mannheim (Germany, F.R.).
J. Altnoder.

Wasserwirtschaft, Vol. 74, No. 11, p 523-529, November, 1984. 2 Fig, 1 Tab, 8 Ref.

Descriptors: *Water treatment facilities, *Mannheim, *Heidelberg, *Germany (Federal Republic), Drinking water, Groundwater, Activated charcoal, Filtration, Chlorinated hydrocarbons, Iron, Manganese.

The Rhein-Neckar Energy and Waterworks Corporation (RHE) supplies 30 cu hm/yr drinking water for 350,000 inhabitants of the Mannheim/Heidelberg area (Federal Republic of Germany) from its four groundwater works - the main facilities at Kafertal (K) and Rheinau, (R) and the Seckenheim (S) and Ilvesheim subsidiary works, which began operating in 1888, 1927, 1962, and 1974, respectively. Ground-water found in Neckar sediments is of prime importance for drinking water since it is iron- and manganese-free. Geohydrological and human influences have made it necessary to treat groundwater at K, R, and S: at K, iron and manganese are removed in an open high-speed filter with surface aeration; and at R and S, chlorinated hydrocarbons (CHC) are removed by activated charcoal. All four waterworks are automated. Since summer 1980, the upper groundwater conductor of the right-Rhine Rhine-Neckar area has been polluted by CHC, and this has affected the R waterworks. This led to the construction of an activated-charcoal filter facility with a capacity of about 3,000 cu m/hr. The filters are in two layers. Water flows through from top to bottom, so that the upper layer is filled with CHC faster; this layer can then be removed and replaced separately from the cleaner lower layer. The facility has reduced CHC content in drinking water to 5 mg/cu m. In 1983, a high-speed decarbonization facility was installed at R for water softening. (Gish-IVI)
W85-04626

FILTER FOAM - PERFECT IN MANY FIELDS (FILTERSCHAUM - PERFEKT IN VIELEN BEREICHEN),

H. J. Ochs.

Wasser, Luft und Betrieb, Vol. 28, No. 10, p 43-46, October, 1984. 5 Fig, 2 Tab, 2 Ref.

Descriptors: *Filters, *Foam filters, Resistance, Flow structure, Permeability, Separation surface, Storage capacity.

Filter layers constructed from foam have been used increasingly in recent years in the water industry. The difference between filters made of foam and those constructed from glass or synthetic fiber is that the latter have heterogenous form and labile structure, while the former have homogeneous form and stable structure. Foam in this sense is defined as a material built of synthetic chains of macromolecules originating from a polyaddition of monomers that is formed into a preconceived three-dimensional shape and solidified. It has closed pores and exhibits irregular pore-web relationships. A special reticulation procedure corrects this by creating open pores of predetermined size that in their spatial relationship with the web approximate ideal conditions. Present technology can produce a foam with optimal permeability, separation surface, flow structure, and frequency of deflection. A second component, in addition to flow, affecting separation is structure; in this case, effectiveness increases with the depth of the permeated filter layer, through increasing the number of particles separated out and through increasing the mass of separated particles up to the saturation point (storage capacity). As filter depth (and density) increases, flow resistance and pressure difference also become greater. The filter layer should be changed when the pressure difference ceases to rise (i.e., when the limit of particle absorption is reached). (Gish-IVI)
W85-04632

GROUND-WATER CONTAMINATION AND WELL CONSTRUCTION IN SOUTHEAST NEBRASKA,

Nebraska Univ., Lincoln. Conservation and Survey Div.

For primary bibliographic entry see Field 5B.
W85-04637

OPTIMIZATION OF SAND RECYCLE RATE IN MOBILE BED FILTRATION,

Asian Inst. of Tech., Bangkok (Thailand).
S. Vigneswaran, C. Visvanathan, and R. B. Aim.

Effluent and Water Treatment Journal, Vol. 24, No. 12, p 457-460, December, 1984. 4 Fig, 2 Tab, 6 Ref.

Descriptors: *Water treatment, *Sand recycling rate, *Mobile bed filtration, Optimization, Filtration, Sand filters,.

The bed clogging problem during contact flocculation filtration has led to the development of mobile bed filters. This type of filter arrangement is designed so that filter grains from the bottom layer are recycled to the top of the bed using an air-lift system. Here the recycled filter grains are washed continuously. Mobile bed deep filter experiments suggest that the compressed air used to lift the sand also helped in the separation of retained particles in the sand. For each filtration velocity there is an optimum sand recycle rate which gives rise to a high removal efficiency. Experiments performed with two different filtration velocities indicate that the optimum sand recycle rate increases with an increase in the filtration rate. The concentration profile decreases with time in the initial stages of mobile bed filtration and remains constant once it has reached the steady state. In theory, the steady state correponds to one cycle time of sand recycle. The optimum sand recycle rate in mobile bed filters for low filtration velocities can be successfully calculated from the clogging front theory with a limited number of laboratory scale fixed bed experiments. (Baker-IVI)
W85-04663

ACID RAIN: DOUSING COMMUNITY RESOURCES,

K. Anderberg.

American City and County, Vol. 100, No. 2, p 38, 42-44, 49, February, 1985. 2 Fig.

Descriptors: *Acid rain, *Water pollution control, *Corrosivity, *Water conveyance, Emissions, Sulfur, Water pollution sources, Air pollution, Water treatment.

While almost everyone agrees that there is a problem regarding acid rain, the differences occur in whether to implement control measures now, or wait for several more years of study to be completed. Most observers are convinced that coal-burning power plants are the major contributors to the problem. In the West, large smelter operations are also identified as sources. Usually, the areas affected are far removed from the actual source. Northeastern states have perhaps the greatest concern about acid precipitation's effect on water quality, since water distribution systems in this region often have been in place for decades and lead piping is far from uncommon. Combined with the historically corrosive nature of the region's water sources and the low buffering capacity of the soil, acid precipitation is cited by many experts as an added burden impacting water quality. The challenge to water system operators focuses on the corrosive water's effect on the distribution system. Treatment can be very expensive, but must be addressed. Only 25% of the water systems in New England currently treat water for corrosivity. The most effective method of protecting consumers from corrosive water and associated contaminants is through corrosion control at the treatment plant. Large-scale plans for sulfur emission control still seem to be a long way off. (Baker-IVI)
W85-04750

CONTROL OF SUSPENDED SOLIDS IN OPEN COOLING WATER SYSTEMS,

J. A. Buchanan.

Water, Sewage and Effluent (Johannesburg), Vol. 9, p 11-16, 1982.

Descriptors: *South Africa, *Cooling water, *Slipstream filtration, *Suspended solids, Dusts, Water circulation, Water treatment, Filtration, Cooling towers.

The control of suspended matter in the circulating water system of cooling towers is discussed. In South Africa, particularly on the Reef, most open cooling water systems experience solids pick up via the cooling tower from the dry dusty environment and, consequently, most industrial cooling towers have been provided with slipstream filtration units. The three main advantages to be gained by the application of slipstream filtration are: 20-30% saving in the amount of chemicals required to maintain the circulating water in the correct chemical condition; almost eliminates the need to shut down the plant to defoul the heat exchange equipment; and increases the overall efficiency of the plant by maximizing the heat transfer efficiencies of the heat exchange equipment. The objective of the slipstream filtration plant is to remove the suspended solids which accumulate in the circulating cooling water and to maintain these solids at an acceptable value. The sizing of slipstream filters is based on a mass balance rather than a water balance across the water recirculating system. The filter must be designed to remove on a continuous basis the same amount of insoluble solids which are entering the system via the tower and the make up water stream. The selection of the right type of filter is also important to achieve the full benefits of slipstream filtration, the two most important properties required by the filter being a high dirt holding capacity and a non-blinding characteristic. (Baker-IVI)
W85-04820

NITRATE CONTAMINATION: PUBLIC AWARENESS,
New York State Coll. of Human Ecology, Ithaca. Dept. of Design and Environmental Analysis.
A. T. Lemley, J. Fessenden-Raden, C. A. Bisogni, and J. M. Holway.
Journal of the American Water Works Association, Vol. 77, No. 2, p p 34-39, February, 1985. 2 Fig, 7 Tab, 3 Ref.

Descriptors: *Nitrates, *Drinking water, *Clifton Springs, *New York, Public opinion, Water treatment, Surveys, Public participation.

The public water supply of Clifton Springs, New York, has had nitrate levels greater than the state mandated maximum contaminant level of 10 mg/L for some time. In 1978 the customers were notified of the problem by mail and in 1981 a citizen's action committee was formed to secure public cooperation in solving the problem. A survey was instituted to assess the effectiveness of notification in influencing public knowledge of the water problem; the public's concerns about water quality and the extent of the public's willingness to pay to correct the problem. Ninety-nine percent of the repondents said they had read of the nitrate problem - some in the letter mailed to their homes, others in newspapers. While the people in general were positive about the quality of their community water supply, all who were willing to pay at least a substantial increase over the present water rates wanted the water to meet exceedingly high standards. The majority of the respondents had no current concerns about the nitrate situation. It is recommended that, in addition to notification through the mail and the formation of citizens' advisory committees, any groups at special risk should be targeted to receive special information and education for future similar problems. (Baker-IVI)
W85-04828

GIARDIA LAMBLIA AND WATER SUPPLY,
Illinois State Water Survey, Peoria. Water Quality Section.
S. D. Lin.
Journal of the American Water Works Association, Vol. 77, No. 2, p 40-47, February, 1985. 5 Fig, 1 Tab, 71 Ref.

Descriptors: *Public health, *Disinfection, *Giardia, Drinking water, Water pollution effects, Water treatment, Pathogenic protozoa, Water analysis, Chlorination, Filtration, Ultraviolet radiation.

The most common waterborne disease in the United States is giardiasis. The morphology and life cycle of the causative agent, Giardia lamblia, the detection of Giardia and the effectiveness of water treatment processes in removing it, and the epidemiology and clinical aspects of giardiasis are discussed. The method of detecting G. lamblia cysts in water includes concentration, separation, and microscopic examination of the cysts. The water sample is filtered aseptically through a Giardia-sampling device. Outbreaks of giardiasis usually involve small municipal water systems or semi-public water systems in recreational areas. There is no evidence that such outbreaks occur in well operated systems with conventional or adequate treatment processes. Most outbreaks result from consumption of untreated surface water or surface water treated with chlorine disinfection alone. Chlorine disinfection with normal dosage and contact time is insufficient to destroy G. lamblia cysts. High dosages and longer contact times are required in water treatment systems in which sedimentation and filtration cannot be employed. Ultraviolet radiation has been considered as a potential alternative to chlorine for disinfection in small systems. However, this method is not sufficient. Disinfectants which have been studied include water sterilizing tablets, Globaline tablets, EDWGT, 2% tincture of iodine, saturated iodine, and bleach. Results of tests with these chemicals are included. The use of filtration is also discussed. (Baker-IVI)
W85-04829

CAUSES OF A WATERBORNE GIARDIASIS OUTBREAK,
Environmental Protection Agency, Denver, CO. Region VIII.
T. E. Braidech, and R. J. Karlin.
Journal of the American Water Works Association, Vol. 77, No. 2, p 48-51, February, 1985. 2 Fig, 13 Ref.

Descriptors: *Drinking water, *Water treatment, *Public health, *Giardiasis, *Colorado, Maintenance, Filter beds, Contamination, Chlorination, Disinfection.

A waterborne giardiasis outbreak occurred within the Highlands Water and Sanitation District in Colorado in November of 1981. While the immediate cause of the outbreak was reduced chlorine contact time due to a pump failure, numerous design and operational deficiencies existed at the plant. These included lack of chemical pretreatment, improper backwashing procedures, poor application of raw water to the filter, and failure to monitor plant conditions. The best alternative for eliminating the potential for outbreaks of giardiasis is to adhere to the multiple barrier concept in treating water. Specifically, this should include chemical addition for coagulation-flocculation, sedimentation, and filtration followed by disinfection. Systems in which the raw water turbidity is generally less than 1 ntu year round have tended to eliminate chemical additives for coagulation flocculation, which may place those served by the system in jeopardy. Further, operation and maintenance programs are commonly inadequate in small systems, particularly with regard to the condition of the filter bed. (Baker-IVI)
W85-04830

REMOVING GIARDIA CYSTS WITH SLOW SAND FILTRATION,
CH2M Hill, Newport Beach, CA.
W. D. Bellamy, G. P. Silverman, D. W. Hendricks, and G. S. Logsdon.
Journal of the American Water Works Association, Vol. 77, No. 2, p 52-60, February, 1985. 9 Fig, 3 Tab, 24 Ref.

Descriptors: *Water treatment, *Drinking water, *Sand filters, *Giardia, Public health, Coliforms, Bacteria, Filtration,.

Pilot plant studies were undertaken to determine the efficiency of slow rate sand filters in removing Giardia cysts and other substances. Giardia cyst removal exceeded 98% for all operating conditions tested. Once a microbiological population is established within the sand bed, removal will be virtually 100%. Coliform removal exceeded 99% and even with new sand was 85%. Removal of standard plate count bacteria and particles ranged from 88 to 91%. Turbidity removal averaged from 27 to 39%. The removal of Giardia cysts, coliform bacteria, standard plate count bacteria, and turbidity declines as the hydraulic loading rate increases. Even at 0.40 m/h, the removal of Giardia cysts and coliform bacteria was high, 99.98 to 99.01%. There was no discernible change in the effectiveness of the filter during short-term reductions in temperature from 15 to 5 C. The effluent concentrations of coliform bacteria and of standard plate count bacteria increase as influent concentration increases. Slow rate sand filtration appears an effective water treatment technology. It is passive in nature, requires little action on the part of the operator, and therefore should be the ideal method for small systems. (Baker-IVI)
W85-04831

EVALUATING SEDIMENTATION AND VARIOUS FILTER MEDIA FOR REMOVAL OF GIARDIA CYSTS,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
G. S. Logsdon, V. C. Thurman, E. S. Frindt, and J. G. Stoecker.
Journal of the American Water Works Association, Vol. 77, No. 2, p 61-66, February, 1985. 12 Fig, 8 Tab, 11 Ref.

Descriptors: *Sedimentation, *Filtration, *Water treatment, *Drinking water, *Giardia, Turbidity, Pilot plants, Public health, Disinfection, Anthracite filters.

The primary purpose of the pilot study described was to evaluate the efficiency of sedimentation and of coarse anthracite media for removing Giardia cysts. Removal of cysts by sedimentation ranged from 65 to 93% and was generally similar to percentage removals of turbidity. The concentration of Giardia cysts was influenced by relatively small turbidity changes (0.2 to 0.3 ntu), increasing greatly as turbidity increased. The coarse anthracite media generally produced water of inferior quality when the bed depths of all filters were similar. Use of high molecular weight, slightly anionic polymer improved the performance of the anthracite filter but made backwashing more difficult. Because cyst concentrations may be higher than usual during the first portion of a filter run (just after backwashing), operators should consider a filter to waste period when a new run is begun. Effective control of Giardia cysts depends on informed application of the multiple-barrier concept. Adequate disinfection is absolutely essential. (Baker-IVI)
W85-04832

REMOVAL OF NEW INDICATORS BY COAGULATION AND FILTRATION,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, B. F. Severin, D. Roy, R. S. Engelbrecht, and A. Lalchandani.
Journal of the American Water Works Association, Vol. 77, No. 2, p 67-71, February, 1985. 5 Fig, 3 Tab, 12 Ref.

Descriptors: *Coagulation, *Filtration, *Water treatment, *Indicator organisms, Disinfection, Yeasts, Coliforms, Acid-fast organisms, Sand filters, Turbidity.

The removal of yeasts and acid-fast organisms by chemical coagulation and rapid-rate sand filtration was compared in laboratory studies with that of the currently accepted group of indicator organisms, total coliforms. The objective was to ascertain the expected removals of indicator organisms when coagulation-flocculation or filtration, or both, are used prior to disinfection. With few exceptions, removals of all indicator organisms by coagulation-flocculation range from 1-2 log units. Among the three indicator groups, there was generally less than a 1-log unit of difference between the removals for each group at optimum conditions for turbidity removal, and when differences existed, the coliform organisms were generally more

readily removed. With sand filtration, removals of the acid-fast and coliform groups of organisms are essentially identical. The yeast organisms are more readily removed in the filtration column. Except for the case of yeast removal by rapid-rate sand filtration, it appears that coagulation-flocculation and filtration as commonly practiced result in removing acid-fast and yeast organisms at an efficiency that is less than, or equivalent to, the removal of total coliform organisms. (Baker-IVI)
W85-04833

BACTERIAL COLONIZATION OF POINT-OF-USE WATER TREATMENT DEVICES,
Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div.
E. E. Geldreich, R. H. Taylor, J. C. Blannon, and D. J. Reasoner.
Journal of the American Water Works Association, Vol. 77, No. 2, p 72-80, February, 1985. 3 Fig, 7 Tab, 26 Ref.

Descriptors: *Drinking water, *Bacteria, *Filtration, Carbon filters, Public health, Coliforms, Water treatment, Pathogenic bacteria.

Point-of-use water treatment devices were investigated to identify organisms that may colonize filters, to determine the magnitude of the postcolonization release of microorganisms into the product water during daily use or after periods of nonuse, and to demonstrate the effect of tap water of marginal bacteriological quality on the quality of the product water. Bacterial colonization occurred in three types of point-of-use carbon filters that are designed to be installed on the cold water line under the sink in the home. Treatment devices that use carbon impregnated paper filters provided favorable habitats for colonization and release of organisms into the product water and bacterial density increases with the length of cartridge service. A changing flora of gram-negative organisms colonized the test units for periods ranging from one to ten months. After a six week period of nonuse, significantly increased bacterial densities were noted in samples taken after an initial flush of a few seconds, with a return to lower densities after several cycles of normal water use. Of the challenge organisms tested, Pseudomonas aeruginosa proved to be the most tenacious, persisting for more than 150 days. While some opportunistic pathogens grew in the carbon filters, the concentration of such organisms released in the product water did not approach the level considered to be infective for a health compromised consumer. The carbon filter treatment devices tested did not provide an effective barrier against Salmonella typhimurium or Escherichia coli, strains of which may be enterotoxigenic. (Baker-IVI)
W85-04834

INFLUENCE OF SUSPENDED PARTICLE SIZE DISTRIBUTION IN DEEP-BED FILTRATION,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Environmental Engineering.
S. Vigneswaran, and R. Ben Aim.
AIChE Journal, Vol. 31, No. 2, p 321-324, February, 1985. 8 Fig, 2 Tab, 4 Ref.

Descriptors: *Suspended solids, *Filtration, *Particle size, *Water treatment, Model studies, Mathematical models, Particle collectors.

Laboratory scale filter experiments were performed using artificial suspension of pollen grains of different sizes. The concentration was measured in terms of number of particles of a particular size per unit volume using a Coulter counter. The first series of experiments was carried out with monodimensional suspensions. The removal efficiency was found to increase with the increase in particle size in the range considered. The role of coarser particles in the removal efficiency of finer particles when they are together in the suspension was studied in a simple case of bidimensional particles in the suspension. As the ratio of coarser particles to finer particles increased, the removal efficiency of finer particles also increased. This effect is more prominent at higher filtration rates. This result confirms the concept of particle collectors. Although this study was performed for a simple case of bidimensional particles in suspension, the experimental observations and the theoretical formulations could be extended to suspensions of particles in a wide range of sizes. (Baker-IVI)
W85-04876

LEACHING OF TETRACHLOROETHYLENE FROM VINYL-LINED PIPE,
Stanford Univ., CA. Dept. of Civil Engineering.
A. H. Demond.
Journal of Environmental Engineering, Vo. 111, No. 1, p 1-9, February, 1985. 3 Fig, 12 Ref.

Descriptors: *Water quality control, *Water distribution, *Pipelines, *Leaching, *Tetrachloroethylene, Drinking water, Water quality.

Tetrachloroethylene (perchloroethylene, or PCE) was used as a solvent for Piccotex, a vinyl-toluene methyl styrene co-polymer, which was then sprayed on the interior of finished asbestos cement pipe. A total of about 1050 miles of pipe were installed before a PCE contamination problem was discovered in water from the pipes. The movement of PCE through Piccotex can be described by the diffusion equation with a concentration dependent diffusion coefficient. Extrapolation of the laboratory drying curves to zero concentration yielded an estimate of the total drying time under idealized laboratory conditions of 1,250 days. Use of this drying time to predict a problem lifetime in the field is difficult. There may exist large differences not only between the laboratory and field environment, but also between individual pipelines in the field. An analysis of some of the differences between the laboratory condition and the field situation supports the conclusion that the leaching of PCE in the field may continue over a longer time period than in the laboratory. (Baker-IVI)
W85-04963

TIME SERIES MODELS FOR TREATMENT OF SURFACE WATERS,
New Hampshire Univ., Durham.
P. J. Ossenbruggen.
Journal of Environmental Engineering, Vol. 111, No. 1, p 27-44, February, 1985. 5 Fig, 6 Tab, 7 Ref, 3 Append.

Descriptors: *Surface waters, *Water treatment, *Model studies, *Time series analysis, Color, Alum, Forecasting, Chemical treatment, Seasonal variation, Probabilistic process.

The use of probability models derived from a long-term (30 yr) color record forms an approach of forecasting raw water color and assigning an alum dose for treatment of surface waters. Three probabilistic models are developed which incorporate the uncertainties associated with forecasting raw water color and alum dose. These forecasts are based upon the risk or probability associated with underdosing. The effect of seasonal and daily color variation is incorporated into one time series model. In the other time series model, daily color variation is considered exclusively. All models are compared for treatment performance. The methods of model identification, parameter estimation, and forecasting are presented for each model. The results indicate that the two time series models are feasible methods because they lead to the judicious use of alum without excessive overdosing. (Author's abstract)
W85-04965

5G. Water Quality Control

DEVELOPMENT AND USE OF A THEORETICAL MATHEMATICAL MODEL FOR THE MEDWAY ESTUARY,
Southampton Water Authority (England).
For primary bibliographic entry see Field 2L.
W85-04450

EVALUATION OF EUTROPHICATION IMPACT IN PUBLIC WATER SUPPLY RESERVOIRS IN EAST ANGLIA,
For primary bibliographic entry see Field 5C.
W85-04451

POLLUTION CONTROL IN THE HUMBER ESTUARY,
Severn-Trent Water Authority (England).
G. M. Woodward.
Water Pollution Control, Vol. 83, No. 1, p 82-90, 1984. 4 Fig, 3 Tab, 2 Ref.

Descriptors: *Humber Estuary, *Water pollution control, *England, Yorkshire, River Trent, River Humber, Estuaries, Suspended solids, Biochemical oxygen demand.

The Humber Estuary is a major estuary extending 62 km from the confluence of the River Ouse and the River Trent to the North Sea. The catchment area draining to the Humber is the largest of any estuary in the United Kingdom with a drainage area covering 27,000 sq km. The estuary is used extensively as a shipping waterway, as a minor commercial fishery and supports some water based amenity, primarily angling and sailing. The most serious pollution problem in the Humber Estuary is the depletion of dissolved oxygen in the area around Trent Falls. The worst conditions occur during periods of low river flow and warm weather when long lengths of the tidal River Ouse may be almost completely deoxygenated. This problem will not be solved until the polluted Yorkshire rivers achieve their river quality objectives and several of the major direct discharges are brought under control following the implementation of the Control of Pollution Act 1974. (Baker-IVI)
W85-04453

HEALTH AND AMENITY ASPECTS OF SURFACE WATERS,
F. Jones, and W. R. White.
Water Pollution Control, Vol. 83, No. 2, p 215-225, 1984. 1 Fig, 2 Tab, 42 Ref.

Descriptors: *Public health, *Water quality control, *Surface waters, *United Kingdom, Wastewater disposal, Bacteria, Fecal coliforms, Disinfection.

The requirements to maintain and improve water quality and to implement European Economic Community directives places considerable responsibility upon the water industry in the United Kingdom. Water quality is generally determined by measuring and interpreting traditional scientific parameters, and by the aquatic life it supports. Monitoring which produces water quality data assists in decisions on suitability for use and determines whether the surface water is conforming to environmental quality standards. Since no inland surface waters have been nominated in Britain for bathing purposes, only those intended for the abstraction and consumption of drinking water will be subject to legally imposed microbiological standards. It is likely that those responsible for medical, veterinary, and environmental health will look to the enumeration of fecal indicator bacteria as a means of assessing health risks posed by polluted surface waters. If, as a result, such officers decide that health risks are unacceptable they have the power to condemn the use of such water for drinking or recreational purposes until remedial measures have been taken. It is possible that Water Authorities will be expected to make improvements to surface water quality, or examine and alter many of their, and industries' activities, where these produce unacceptable conditions. In some circumstances disinfection of unsatisfactory discharges may have to be resorted to. Such developments have obvious implications for Water Authorities. They may be forced to re-examine their capital programs in a new light and reassess their strategies for monitoring, analysis, data collection and interpretation. (Baker-IVI)
W85-04457

LEA MARSTON PURIFICATION LAKE: OPERATIONAL AND RIVER-QUALITY ASPECTS,
Severn-Trent Water Authority (England).

D. R. Woods, M. B. Green, and R. C. Parish.
Water Pollution Control, Vol. 83, No. 2, p 226-242, 1984. 9 Fig, 7 Tab, 6 Ref.

Descriptors: *Tame River, *England, *Lea Marston Purification Lake, *Purification, *Water quality control, Monitoring, Heavy metals, Sludge disposal, Suspended solids, Biochemical oxygen demand.

The problem of high pollution load in the Tame River under normal flow conditions and the grossly polluting effects of heavy rainfall high in the catchment led to plans for a series of purification lakes to improve river quality. The first lake in the system became operational in July 1980. In flood conditions a considerable quantity and variety of waste material dumped along the river banks is picked up and conveyed to the Lea Marston site. The importance of an effective debris barrier on a river draining an urban area is demonstrated. The Mudcat dredger is an effective tool for removal of sludge; however, additional work is needed with different dredging patterns and an investigation of the effects of sludge consolidation and digestion on the lake bottom are needed to determine the most cost-effective mode of operation with least risk of sludge solids being resuspended. It is strongly recommended for systems being planned elsewhere that long term disposal arrangements for the dredged material be secured before a lake is commissioned. The sludge removed is unsuitable for agricultural disposal. The lake has proved capable of removing a large proportion of the suspended solids and associated BOD loads swept forward during the storm conditions, thus protecting the river downstream. (Baker-IVI)
W85-04458

DESIGN AND OPERATION OF THE PURIFICATION LAKES IN THE RUHR VALLEY,
K. R. Imhoff.
Water Pollution Control, Vol. 83, No. 2, p 243-253, 1984. 9 Fig, 5 Tab, 19 Ref.

Descriptors: *Ruhr Valley, *Germany (Federal Republic), *Purification lakes, *Water quality control, Rivers, Water quality control, Costs, Phosphorus, Wastewater treatment, Storm wastewater.

In the Ruhr valley five purification lakes are successfully operated to improve river water quality, to diminish the residual pollution of sewage-treatment plants, storm-sewage overflows and non-point sources at comparatively low cost. The purification capacity of Lake Baldeney is for instance in the order of 100,000 BOD population equivalents. Its operational cost is only one third and, adding the cost of desludging, two thirds, of the cost of one sewage-treatment plant of the same capacity. In reality, perhaps ten tertiary-treatment steps would have to be added to existing biological plants and be operated at a much higher expenditure to reach the same result. The efficiency of the other lakes can be assumed in proportion to their relative size. Because of the high phosphorus content of the water, uncontrolled mass development of algae may endanger the oxygen balance of the river and the treatment capacity of the water works. Purification lakes therefore should be designed with not more than two days' retention time at low flow. The same rule is applied to polishing lagoons but in this case the volume preferably should be split up into several units with a water depth between 1 and 2 m. With regard to phosphorus, a strategy has been developed to lower the phosphorus concentration in the River Ruhr by simultaneous precipitation of phosphates in the activated-sludge tanks of the treatment plants. The purification lakes store a considerable amount of water of good quality which dilutes shock loads like storm-sewage discharges. In the middle and lower Ruhr consequently no fish kill has been caused by such sources. (Baker-IVI)
W85-04459

WATER RECLAMATION AND RIVER MANAGEMENT IN THE TAME BASIN,
Severn-Trent Water Authority (England).
M. H. Box.
Water Pollution Control, Vol. 83, No. 2, p 254-264, 1984. 4 Fig, 11 Ref.

Descriptors: *Tame Basin, *England, *River management, Water quality control, Purification lakes, Flood control, Wastewater treatment facilities, Sewers.

The River Tame has been neglected. The need to reverse the pollution and strangling of the river by industrial development and its attendant population was seen 60 years ago. Far-seeing engineers worked out proposals to correct that state of affairs, but little was done as the political will and organizations necessary to tackle the work had not then been found and national recognition of the importance of clean rivers was needed before finance was made available. The water authorities created in 1974 have the powers to tackle river pollution and management problems as a whole. In the Tame Basin a scheme has been undertaken which shows major benefits and cost savings over the various approaches adopted independently by predecessor authorities. This has only been achieved by constant pressure to ensure that the needs of the West Midlands conurbation were not neglected in the face of all the other diverse calls on the attention of such a large authority. The scheme will involve the improvement of sewage treatment works, the construction of a purification lake, the construction of 45 km of sewers, and flood control measures. (Baker-IVI)
W85-04460

INVESTIGATION INTO THE HYDRAULIC RESOURCES OF A LAGOON IN PORTUGAL,
Consultores de Engenharia Sanitaria Lda., Lisbon (Portugal).
M. C. Bailey, and J. Q. Levy.
Water Pollution Control, Vol. 83, No. 3, p 327-339, 1984. 5 Fig, 6 Tab.

Descriptors: *Lagoons, *Portugal, *Lagoa de Obidos, Water quality control, Water management, Decision making, Planning, Coastal waters, Sedimentation, Eutrophication, Water pollution effects.

The Lagoa de Obidos is a natural lagoon, principally saline, which is located 85 km north of Lisbon on the Atlantic western coast of Portugal. It has a maximum surface area of about 6 sq km and is separated from the sea by a substantial sand bar, containing a gap through which sea water passes on each tide. The lagoon is important as a recreational and holiday retreat for many Portugese people. The lagoon is suffering from problems which are effectively reducing its life and amenity value. These problems include silt, which is being carried by the rivers to the lagoon and is settling and reducing the volume of water in the upper reaches; a net transport of sand from the sea into the lagoon at the downstream end where large sand-banks are being established; and pollution and eutrophication problems. Three master plans are defined for solving or controlling each of the problems. Priorities are addressed and recommendations made for the staged implementation of the solutions. (Baker-IVI)
W85-04461

LARGE-SCALE FIELD EXPERIMENT IN THE CONTROL OF EUTROPHICATION IN THE NORFOLK BROADS,
G. L. Phillips.
Water Pollution Control, Vol. 83, No. 3, p 400-408, 1984. 7 Fig, 2 Tab, 9 Ref.

Descriptors: *Water quality control, *Eutrophication, *Norfolk Broads, *England, River Ant, Barton Broad, Phosphous removal, Wastewater treatment facilities, Industrial wastewater, Phytoplankton.

The installation of phosphorus removal at all significant sewage-treament works and industrial discharges in the River Ant catchment has reduced the phosphorus load to Barton Broad by about 60%. A significant amount of this may be resuspended particulate phosphorus due to boat activity, and it is not known if this is available to algae. Phosphorus concentration in Barton Broad during winter and early spring is about 0.1 mg/l total P, the target established at the onset of the experiment. Phosphorus is released from the sediment in Barton Broad during the summer and this can enable large phytoplankton populations to develop. At present there is no evidence that without further intervention submerged aquatic plant populations will be re-established. (Baker-IVI)
W85-04465

BIOLOGICAL CONSIDERATIONS IN THE SETTING OF QUALITY STANDARDS FOR THE TIDAL THAMES,
Thames Water Authority (England). Northern Div.
M. J. Andrews, J. E. C. Steel, and A. G. Cockburn.
Water Pollution Control, Vol. 82, No. 1, p 52-60, 1983. 1 Fig, 4 Tab, 46 Ref.

Descriptors: *Water quality standards, *Thames River, *England, Estuarine environment, Dissolved oxygen, Fish, Invertebrates, Water quality control, Tidal waters.

Guidelines have been described for setting biological standards of estuary quality applicable to the Thames, which are related to the dissolved oxygen regime that may be present. It should be noted that under conditions of pollution amelioration, fish, being generally much more mobile will recover more quickly than sedentary benthic macroinvertebrates. The mobile invertebrates (for example shrimp, prawns and crabs) will recolonize at a rate intermediate between that of fish and sedentary macroinvertebrates. Care should be taken when assessing dissimilar rivers and geographical distribution of species and natural levels of potential contaminants must be considered. It is up to those with river management responsibility to decide what community structure they consider acceptable in their rivers and they must take into account the cost of bringing rivers to, or maintaining them at, a particular standard. (Baker-IVI)
W85-04509

INDUSTRIAL EFFLUENT CONTROL IN THE NETHERLANDS AND LEGISLATION IN THIS FIELD IN SOME OTHER EUROPEAN COUNTRIES,
Water Authority Hollandse Eilanden en Waarden, The Netherlands.
H. A. Meijer.
Water Pollution Control, Vol. 82, No. 2, p 213-226, 1983. 1 Fig, 6 Tab, 1 Ref.

Descriptors: *Water pollution control, *Industrial wastes, *Legislation, *Netherlands, Water quality control, Regulations, Economic aspects, Pricing.

The Netherlands is one of the most densely inhabited countries in the world with a population of 14 million in an area of 37,000 sq km. The thirty regional water quality agencies are not only in charge of the discharge licensing policy, but are also concerned with building and operating sewage-treatment plants for towns and villages. The Pollution of Surface Water Act features two main points. Every discharge of waste water into a surface water is subject to a discharge license from the manager of the receiving water. The water quality manager may stipulate conditions concerning the quality and quantity of the effluent to be discharged. The Act stipulates that each discharger of waste water into surface water or a sewer has to pay a pollution levy. The decentralized approach to implementation of the Pollution of Surface Waters Act brings some measures of variety in its wake and therefore a sound co-ordination policy is of prime importance. Summaries are given of recommendations concerning restriction of discharges on non-oxygen-consuming and toxic substances from existing processes in the metal industry; recommendations concerning limitation of discharges of non-oxygen-consuming and toxic substances from formulating pesticides; and recommendations concerning limitation of discharges of non-oxygen-consuming and toxic substances from paint, lacquer and printing ink manufacturers. Results of remedial actions undertaken by industries are presented. (Baker-IVI)

W85-04520

POLLUTION CONTROL POLICIES FOR THE TEES ESTUARY,
Northumbrian Water Authority, Gosforth (England).
J. A. Brady, R. G. Stead, and W. O. Ord.
Water Pollution Control, Vol. 82, No. 3, p 367-380, 1983. 3 Fig, 6 Tab, 21 Ref.

Descriptors: *Water pollution control, *Tees Estuary, *England, Public policy, Estuaries, River Tees, Legal aspects, Water quality, Water quality control, Fish migration, Salmonids, Wastewater treatment.

The River Tees rises at Cross Fell in the Pennines, 893 m above sea level, and flows for some 160 km to the North Sea. Tees-side has a population in excess of 400,000 and is a major industrial development area with port facilities. Water quality targets for the Tees Estuary were developed. The first target area was to be the removal of gross nuisance, including odor and visual nuisance. Water quality in the upper Tees catchment was sufficient to support the initial development of young salmonids, but the second target was to upgrade estuarial quality to support the young fish when they migrate to the open sea. The third quality target area was to upgrade estuary quality at all times, not just when migratory fish were passing through. Relevant water quality parameters included water temperature, ammoniacal nitrogen, cyanide and phenols, and heavy metals. Modeling studies and targets considered include the relationship between depth-averaged and near surface concentrations, effluent loads to achieve targets, and fish migration. The construction of the Portrack primary treatment works to be completed will give partial achievement of the first target by removing odor nuisance by 1985. Regular monitoring of the estuary water quality is to begin and continue to enable conditions under which the second target could be achieved to be understood with greater accuracy. (Baker-IVI)
W85-04525

POLLUTION MANAGEMENT AND THE TIDAL THAMES,
Thames Water Authority (England). Northern Div.
P. J. Lloyd, and A. G. Cockburn.
Water Pollution Control, Vol. 82, No. 3, p 392-401, 1983. 9 Fig, 1 Tab, 11 Ref.

Descriptors: *Water pollution control, *Environmental effects, *Thames River, *England, *Tidal waters, Estuaries, Nutrients, Dissolved oxygen.

A method of pollution management is demonstrated which allows for the interaction of several discharges. In tidal waters there is a complex interaction between discharges as the to and fro movement of the water can cause discharge to have effects both upstream and downstream of the point of entry to the estuary. There are several critical points along the course of a river where, for either physical conditions or the location of discharges, the river will tend to show the maximum effect of discharges in relation to quality control objectives. Monitoring at these points will ensure correct knowledge of the condition of the river as a whole. Where a critical point is due to the cumulative effect of a number of discharges then the available capacity at this point could be regarded as a pollution budget which could be equitably allocated according to the need of a discharge. In controlling a cumulative critical point a discharge may not be able to utilize available capacity upstream. The maximum effect of a discharge, as measured by dissolved oxygen (DO) deficit produced, occurs close to the point of discharge. The management of the critical point is carried out such that for discharges of the same load but at different locations, those nearer the seaward end will be able to discharge a greater load. The Thames River Estuary is taken as an example of an estuary where a policy for the regulation of DO by the setting of consent standards is in the process of being implemented. (Baker-IVI)
W85-04527

EFFICIENCY OF LIMING IN ACID, HUMUS-INFLUENCED LAKES,
Norwegian Liming Project, Arendal.
D. Hongve, and H. Abrahamsen.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 700-703, October, 1984. 2 Fig, 1 Tab, 7 Ref.

Descriptors: *Acid lakes, *Liming, *Humus, Organic matter, Iron, Aluminum, Calcium, Limestone, Lake sediments, Lake restoration.

Experiments were devised to quantify the effects of humus in water using a small mesohumic lake. The dry sediment of the lake is about 50% organic, the other 50% is mainly iron and aluminum compounds. Mean depth is 2.4 m and theoretical residential time is 0.28 year. The lake was dosed with limestone flour in June 1981 at a rate of 60 g/cu m, of which 34% dissolved instantaneously and 10% during the following month. Then a period followed when calcium disappeared from the water. The loss was attributed to loading of the sediment with dissolved calcium. After two water renewals 46% of the lime had benefited the water quality. After 15 months and four water renewals 65% of the lime dose was used. The polyhumic lake studied has a mean depth of 3.5 m and theoretical residence time of 0.76 years. Lime dose in March of 1981 was 1.0 kg/cu m. Less than 10% dissolved during the first two weeks after icebreak. Thirty-six percent have been used during two water renewals. The natural calcium concentration in these lakes is 1-2 mg/l. After liming the concentration has stabilized for long periods at 4-5 mg/l. The final efficiency in these whole scale liming experiments seems to be as good or better than what can be expected for lake liming. It will be necessary to not only investigate water chemistry, but also to measure base saturation and capacity for ionic exchange in the sediments. (Baker-IVI)
W85-04533

SHORT-TERM EFFECTS OF LIMING ON SEDIMENT OXYGEN UPTAKE IN AN ACID LAKE,
Lund Univ. (Sweden). Limnological Inst.
G. Gahnstrom.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 760-764, October, 1984. 2 Fig, 2 Tab, 10 Ref.

Descriptors: *Liming, *Acid lakes, *Oxygen, *Lake sediments, *Lake Gardsjon, *Sweden, Bacteria, Lake restoration, Vegetation, Phytoplankton, Environmental effects.

The objectives of this liming program are to restore acidified freshwaters and to prevent further acidification of freahwaters that are of special importance to fishing and nature conservation. The studied area is situated on the Swedish west coast, 50 km northeast of Goteborg. Sediment was sampled in three lakes in the area, Lakes Gardsjon, Stora Hastevatten and Gaffeln. After liming of Lake Gardsjon, the pH of the overlying water and surface sediments was increased by 2-4 pH units. In May of 1982, two weeks after liming, sediment oxygen uptake decreased 10-40% at all sampling sites in the lake and remained at this lower level at the June sampling, 6 weeks after liming. The initial decrease in sediment oxygen uptake in Gardsjon after liming is most probably due to the drastic change in water chemistry brought about by the addition of calcium carbonate. The increase in sediment oxygen uptake in Gardsjon occurring 3-4 months after liming was probably mediated by an increased supply of organic matter to the sediments from decaying benthic vegetation and increased phytoplankton biomass. Much of the Sphagnum-mats and benthic algae occurring over 90% of the lake bottom was killed after liming. The low pH and high metal content of surface sediment after liming may explain why there was no increase in sediment bacterial populations. Changes in the structure of the microbial community due to increased pH may increase the ability of the microbial community to utilize organic matter stored in the sediments, thus increasing sediment oxygen uptake. (Baker-IVI)
W85-04537

ACIDIFIED LAKES: ECOSYSTEM RESPONSE FOLOWING SEDIMENT TREATMENT WITH SODIUM CARBONATE,
Lund Univ. (Sweden). Limnological Inst.
G. K. Lindmark.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 772-779, October, 1984. 8 Fig, 2 Tab, 15 Ref.

Descriptors: *Acid lakes, *Lake sediments, *Liming, *Sodium carbonate, *Lake Lilla Galtsjon, *Sweden, Lake restoration, Acidification, Acid deposition, Neutralization, Environmental effects, Aquatic life.

Lake Lilla Galtsjon is a small forest lake in southeastern Sweden with a water retention time of about 3.5 years. The lake has become acidified due to acid deposition. In October of 1980 a 10% solution of sodium carbonate, formed by dissolving 40 tons of water free sodium carbonate in lake water, was injected into the sediment by a harrow-like device. The treated area was 25% of the total lake area and the addition was 5.1 eq of base/sq m lake surface. Before treatment Lake Lilla Galtsjon was a typical soft-water acid-damaged lake with pH varying between 4.8 and 5.3. After treament no extremely high pH values were recorded in the water, but values were appropriate to lake biota. During summer stratification the deep hypolimnetic water becomes anoxic. The resulting sulfate reduction causes temporarily elevated pH and bicarbonate generation. No oxygen depletion was observed during winter stratification. The improvement of lake water alkalinity after treatment was ideal. During the stratification periods the diffusion of bicarbonate and sodium ions from the sediment becomes obvious; a salinity gradient develops in the hypolimnetic water column. The short-term results were positive. Lake water quality improved to the desired level. Lake biota responded with a recovery in algal species diversity, in fish reproduction and in distribution of isoetides in the littoral zone and other factors. With respect to the sodium base in the sediment, losses to deeper sediment layers were unavoidable in this experiment. (Baker-IVI)
W85-04539

LOOSDRECHT LAKES RESTORATION PROJECT, AN INTRODUCTION,
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2H.
W85-04544

LOOSDRECHT LAKES RESTORATION PROJECT: HYDROLOGY AND PHYSICO-CHEMICAL CHARACTERISTICS OF THE LAKES,
Vrije Univ., Amsterdam (Netherlands). Dept. of Hydrogeology and Geographical Hydrology.
For primary bibliographic entry see Field 2H.
W85-04545

LOOSDRECHT LAKES RESTORATION PROJECT: SEDIMENT PHOSPHORUS DISTRIBUTION AND RELEASE FROM THE SEDIMENTS,
Limnologisch Inst., Nieuwersluis (Netherlands).
For primary bibliographic entry see Field 2K.
W85-04546

EFFECTS OF INTERNAL MEASURES IN BALDEGGERSEE: FORCED-CIRCULATION AND OXYGENATION OF THE HYPOLIMNION (DIE AUSWIRKUNGEN VON INTERNEN MASSNAHMEN IM BALDEGGERSEE: ZWANGSZIRRKULATION UND SAUERSTOFFBEGASUNG DES HYPOLIMNIONS),
Luzern Kantolales Amt fuer Gewasserschultz (Switzerland).
P. Stadelmann, T. Joller, and D. Imboden.
Verhandlung Internationale Vereinigung Limnologie, Vol. 22, p 1052-1065, October, 1984. 8 Fig, 4 Tab, 12 Ref.

Descriptors: *Baldeggersee, *Switzerland, *Eutrophic lakes, *Lakes, *Oxygenation, *Destratifica-

tion, Meromictic lakes, Aeration, Dissolved oxygen, Ammonium, Sulfur, Methane, Iron.

With phosphorus concentrations of 300 mg P/cu m and primary production rates of about 400 g C/sq m/year the Baldeggersee (Switzerland) is highly eutrophic. The lake is meromictic and shows also during winter time below 40 to 66 m anoxic conditions. In 1976, 11.3 tons phosphorus entered the lake, while the critical P-loading is 2 tons per year. Since the P-loading can be decreased by external measure only to about 6 tons per year, the lake was restored by means of destratification and oxygenation of the hypolimnion. In winter 1982 the lake was destratified by bubbling compressed air in a depth of 60 m (200 m cu m/h). Within two weeks the whole lake circulated and for a first time since 1958, 4 mg O2/l could be measured down to 66 m. In summer 1982 the technical device for oxygenation of the hypolimnion with small bubbles of pure oxygen gas was tested. Starting from May 1983, 4.5 tons O2 per day were successfully brought into the hypolimnion. The reduced substances (NH4(+), S(2-), CH4, Fe(2+)) disappeared and the anoxic conditions changed to aerobic ones. The six oxygen diffusors were placed at depths of 40 to 60 m and no extremely high oxygen concentrations were observed, indicating a good horizontal and vertical transport of oxygen. By means of artificial destratification in winter and oxygenation of the hypolimnion in summer the deep Baldeggersee exhibited again aerobic conditions. Any apparent toxicity for fish could not be detected either through chemical measurements (O2 oversaturation, N2, NO2) or by observation of the biota. (Author's abstract)
W85-04559

LINEAR PROGRAMMING MODEL FOR THE CONTROL OF COMBINED SEWER SYSTEMS WITH OFF-LINE STORAGE FACILITIES,
California Univ., Davis. Dept. of Civil Engineering.
G. G. Patry.
Canadian Water Resources Journal, Vol. 8, No. 1, p 83-105, 1983. 4 Fig, 5 Tab, 17 Ref. Natural Sciences and Engineering Research Council of Canada grant A-1005.

Descriptors: *Computer models, *Combined sewer overflows, *Storm Water, *Water storage, Model studies, Storage, Overflow, Impact assessment.

Effective and economical measures to control the impacts of storm related pollution are difficult to achieve; overflows from combined sewer systems occur at the junction of combined sewer collectors and the sanitary sewer interceptor. Real-time control of these sewer networks is of increasing interest in the overall pollution control management program. Under reactive (or local) control decision variables are evaluated at every time step based solely on the status of the system at that particular time. The adaptive (or predictive) level of control is based on the sequential and systematic updating of storm inflow forecasts as new information on the storm event is being gathered through an automated data aquisition system. While minimizing the impact on receiving waters is the most desirable objective function, it is by far the most difficult to achieve. Three levels of action are involved: forecast, optimization, and impact assessment. A model was developed which relies on runoff predictive capabilities to minimize the impacts on the receiving waters from combined sewer outflows. The model handles time and spatial sensitivity of the receiving waters as well as off-line storage facilities. Variations in the rates of runoff from different storm patterns have a significant influence on the value of the objective function for any specific set of coefficients and available levels for off-line storage. The overflow and storage patterns for each of the events simulated are quite different from each other and can only be predicted through the use of an optimization scheme. Use of the model for real-time applications is presently underway. (Collier-IVI)
W85-04576

METHODOLOGY FOR POLLUTION CONTROL DECISION ANALYSIS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
E. A. McBean, and G. Zukovs.
Canadian Water Resources Journal, Vol. 8, No. 2, p 64-87, 1983. 3 Fig, 7 Tab, 14 Ref.

Descriptors: *Pollution control, *Decision making, Administrative decisions, Impacts, Financial aspects, Evaluation, Alternative planning.

The implementation of pollution control alternatives results in potentially very diverse impacts. Some of these impacts are quantifiable in monetary terms whereas others are non-commensurate. For many situations, a number of sources may be contributing, different types of contaminants may be exceeding water quality guidelines, and the violations may occur under different circumstances. Many decision-makers, with individual biases, must implement measures to resolve a problem. A two-stage matrix methodology is developed for use in the selection of pollution control strategies. The initial state is a cursory or screening assessment level used to identify whether additional study is needed. The second stage includes the determination of the various alternatives for pollution control on a set of evaluation criteria. Dominance testing is used to select the best alternative. The methodology is relatively straightforward in application with the principal advantages being that it is applicable to a wide array of problems and provides a structure for organizing the information into a logical progression towards alternative selection. (Moore-IVI)
W85-04582

TREATMENT OF FERRUGINOUS GROUND WATER FROM AN ABANDONED COLLIERY,
For primary bibliographic entry see Field 5D.
W85-04596

SYSTEM OF PRACTICES FOR PREVENTING WATER BY AGRICULTURAL CHEMICALS,
Ukrainian Research Inst. of Forestry and Agriculture, Ivanovo-Frankovsk (USSR).
P. S. Pasternak, N. N. Prikhod'ko, Yu. D. Matukhno, and V. P. Landin.
Soviet Soil Science, Vol. 16, No. 2, p 131-136, March-April, 1984. 2 Tab, 13 Ref. Translated from Agrokhimiya, No. 3, p 61-65, 1984.

Descriptors: *Water pollution control, *Agricultural chemicals, *Shelterbreaks, Soil erosion, Agricultural watersheds, Agricultural runoff, Surface runoff, Drainage basins.

The pollution of water by agricultural chemicals and products of soil erosion is a function of surface runoff, which is the principal route by which fertilizers and pesticides reach lakes and streams. The principles for effectively protecting water against pollution are reduced to the following: minimizing the concentrations of agricultural chemicals in runoff; and decreasing the volume of surface runoff from the fields reaching water sources. A leading role in protecting bodies of water is assigned to a system of shelterbelts in drainage basins. A system of shelterbelts in a drainage basin is based on the contour organization of the area and constitutes the framework within which other measures to regulate and purify surface runoff in the drainage basin are coordinated. The result is an agricultural landscape with a contour-strip structure. The introduction of water protection systems into drainage basins is at present the most effective and least expensive technical solution to the problem of preventing the pollution of bodies of water by agricultural chemicals and soil erosion products. (Moore-IVI)
W85-04619

LONG-TERM GROUNDWATER PROTECTION WITH PLASTIC LININGS (LANGFRISTIGER GRUNDWASSERSCHUTZ MIT KUNSTSTOFF-DICHTUNGSBAHNEN),
Beratender Ingenieur fur Kunststofftechnik im Bauwesen. Schwerpunkt: Wasserbau, Grundwasserschutz, Erd- und Grundbau.
F. W. Knipschild.
Wasser, Luft und Betrieb, Vol. 28, No. 10, p 64-69, October, 1984. 1 Tab, 17 Ref.

Descriptors: *Linings, *Landfills, *Water pollution prevention, Groundwater pollution, Plastics, Waste disposal, Plastics, Materials engineering.

The behavior of plastic linings used to protect groundwater from pollution originating in trash and garbage dumps can be influenced over the long term by the passage of time, high temperatures, chemical composition of the dump, and weather. Hard PVC has significantly greater tensile strength than the partially crystalline polyethylene HDPE up to 60 C but is unusable at higher temperatures, whereas HDPE can be used up to 100 C. Tests of mechanical influences over time can take the form of isochronous stress-strain lines, creep graphs, and relaxation graphs; temperature can be incorporated into these charts to provide profiles for up to 50 yr for various materials. Linings must remain functional for the time span of the dump, but assessment of their long-term behavior is difficult because the exact composition of percolating water cannot be predicted, and mechanical influences can only be determined through detailed knowledge of subterranean conditions. For preliminary assessment, tests in which the sealing material is immersed in a fluid resembling the percolating water to determine weight changes and alterations in short-term mechanical characteristics are sufficient. An HDPE sealant may last 30 yr. HDPE is also suitable for use with hydrocarbons, since tests have shown that changes in HDPE caused by these are reversible. Experiments on HDPE-sealants resistance to weathering have led to the estimation of a 20-yr life span in central Europe. (Gish-IVI)
W85-04633

BIOMANIPULATION EXPERIMENT IN GREEN LAKE, SEATTLE, WASHINGTON,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. A. Goad.
Archiv fur Hydrobiologie, Vol. 102, No. 2, p 137-153, December, 1984. 5 Fig, 2 Tab, 29 Ref.

Descriptors: *Biomanipulation, *Green Lake, *Seattle, *Washington, *Algae control, *Water quality, Fish, Algae growth, Planktivors, Cyanophyta, Trout, Perch, Phytoplankton, Zooplankton.

Biomanipulation was investigated as a method for reduction of algal blooms in Green Lake. Water quality problems occur during the summer when blooms of blue-green algae (Gloeotrichia, Anabaena, and Aphanizomenon) form in the lake; this period coincides with the greatest recreational use of the lake. The effects of two types of planktivorous fish, young-of-the-year perch and 120 mm long rainbow trout, on the zooplankton and phytoplankton communities were examined using three enclosures containing fish and one enclosure without fish. The enclosures containing fish had less zooplankton (as much as an 80% reduction), greater concentrations of chlorophyll (as much as a 160% increase), and alterations in the composition of both zooplankton and phytoplankton populations. The enclosure without fish had a higher abundance of zooplankton and generally a lower phytoplankton biomass. The results of the manipulations varied according to the stocking rate and the type of fish in the enclosures. The highest density of perch (1500 kg/ha) showed the greatest effect. Feeding activity of the trout was probably affected by temperature stress and lack of ability of the hatchery-raised fish to feed in natural conditions. Assuming the conditions in the enclosures were somewhat representative of conditions in the lake, biomanipulation is a feasible approach to the restoration of Green Lake if conducted with discretion. (Collier-IVI)
W85-04671

GROUNDWATER QUALITY PROTECTION: THE ISSUE IN PERSPECTIVE,
Robert S. Kerr Environmental Research Lab., Ada, OK.
C. W. Hall.
Environmental Professional, Vol. 6, No. 1, p 46-51,

1984. 12 Ref.

Descriptors: *Groundwater contamination, *Water quality management, *Environmental protection, Legislation, Research priorities, Fate of pollutants.

An effective program for groundwater protection must include not only a workable legal framework for administration, but also a sound scientific understanding of the occurrence and movement of groundwater and the behavior of contaminants in the subsurface environment. The legislative basis for developing and implementing broad groundwater quality protection programs exists, although it is dispersed in a variety of pieces of legislation. Such programs presuppose the existence of the scientific knowledge necessary to produce viable and effective results from its implementation. The processes that govern the behavior of pollutants in the subsurface can be divided for research purposes into the major areas of hydrologic, abiotic, and biotic. These processes will act to influence: the movement of water; the physical and chemical interactions that will cause pollutants to move at rates different from those of the water; and chemical or microbial alterations that will remove pollutants from the subsurface or render them into insoluble constituents at the surface matrix. The elucidation of the importance and magnitude of the various mechanisms functioning in the three process areas will ultimately provide the knowledge to integrate the influences of these processes into a singular understanding of pollutant behavior in the subsurface. Research under each of these process areas is organized into a series of tasks focusing on methods development, subsurface characterization, pollutant attenuation, process kinetics, field application, and mathematical model development and application. Expanded knowledge of pollutant behavior in the subsurface environment is fundamental if we are to take effective action to prevent or limit groundwater pollution or to rehabilitate already contaminated systems. (Collier-IVI)
W85-04683

IMPORTANCE OF SAMPLE DISCRIMINATION IN USING THE TRAVEL COST METHOD TO ESTIMATE THE BENEFITS OF IMPROVED WATER QUALITY,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 6B.
W85-04753

WATER UTILITY IN THE NUCLEAR AGE,
For primary bibliographic entry see Field 5B.
W85-04773

EUTROPHICATION CONTROL AND THE FALLACY OF NITROGEN REMOVAL,
Maryland Dept. of Health and Mental Hygiene, Baltimore. Office of Environmental Programs.
A. P. Sincero.
Pollution Engineering, Vol. 16, No. 11, p 33-36, November, 1984. 2 Fig.

Descriptors: *Nitrogen removal, *Eutrophication, *Water quality control, Nitrogen cycle, Nutrients, Nitrogen fixation, Microorganisms, Phosphorus.

To better understand the use of nitrogen by microorganisms, the nitrogen cycle and the concept of the limiting nutrient are described. With these ideas in mind, the advisability of removing either phosphorus, nitrogen, or both nutrients in order to combat eutrophication is considered. Literature abounds with proof that organisms fix nitrogen both in salt and fresh waters. In the absence of NH4(+), NO2(-), and NO3(-), which are needed for protein synthesis, N2 from the air can be fixed to produce NH4(+). As a result the removal of nitrogen to control eutrophication would be a wrong approach. Since P is a spare part in the makeup of living bodies, and since its absence will prevent the synthesis of bone, controlling phosphorus is the only sufficient condition to control eutrophication, assuming all other factors remain constant. (Baker-IVI)
W85-04774

ACID DEPOSITION CONTROL, A BENEFIT-COST ANALYSIS: ITS PROSPECTS AND LIMITS,
Wyoming Univ., Laramie. Dept. of Economics.
For primary bibliographic entry see Field 6B.
W85-04798

RESPONSES OF SOCKEYE SALMON (ONCORHYNCHUS NERKA) TO FERTILIZATION OF BRITISH COLUMBIA COASTAL LAKES,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
For primary bibliographic entry see Field 8I.
W85-04847

PHYTOPLANKTON RESPONSES TO REDUCTION AND ELIMINATION OF SUBMERGED VEGETATION BY HERBICIDES AND GRASS CARP IN FOUR FLORIDA LAKES,
Rollins Coll., Winter Park, FL. Dept. of Biology.
D. I. Richard, J. W. Small, Jr., and J. A. Osborne.
Aquatic Botany, Vol. 20, No. 3/4, p 307-319, December, 1984. 1 Fig, 3 Tab, 41 Ref.

Descriptors: *Phytoplankton, *Aquatic weed control, *Florida, Clear Lake, Little Lake Fairview, Lake Orienta, Lake Mann, Submerged plants, Herbicides, Grass carp, Lake restoration, Macrophytes, Aquatic plants, Cyanophyta, Diatoms, Biomass.

Four central Florida lakes were monitored for 3 years to determine the effects of macrophyte reduction and elimination by grass carp and herbicide on phytoplankton populations. Clear Lake, in which grass carp were stocked after a year of baseline studies, had all macrophytes eliminated within 14 months. The density of phytoplankton increased significantly from an initial 24-month mean of 165 000 cells/l to a mean level of 787 900 cells/l in the third year. In Little Lake Fairview, stocked with grass carp in both the first and third years of study, vegetation was not eliminated until the 34th month. Phytoplankton density increased significantly from a 24-month mean of 64 200 cells/l to a mean of 370 200 cells/l in the third year. Lake Orienta, stocked with grass carp in the first year, had all vegetation eliminated within 6 months. Phytoplankton abundance did not change significantly over the course of the study (mean: 2700 000 cells/l). Lake Mann was treated with herbicide alone after an initial year of baseline data collection. Submerged vegetation was reduced in the second year but increased to near initial biomass levels in Year 3, with Nitella sp. replacing Hydrilla verticillata (L.f.) Royle as the dominant macrophyte. No significant yearly changes were noted in density of phytoplankton in this lake. Lake Orienta was the only lake in which the number of phytoplankton species collected differed significantly between years. Cyanophytes (notably species of Anacystis, Microcystis and Anabaena) and the diatom, Fragilaria sp., predominated in all lakes as macrophytes were removed. Most changes observed were in the direction of apparent increased trophic state. Major shifts in the phytoplankton assemblage (e.g., Shannon diversity indices and abundance) coincided with periods of maximal fluctuation in vegetation. Reversals of these tendencies were observed during prolonged stable periods of both high and low macrophyte biomass. (Author's abstract)
W85-04857

CHANGES IN THE OXYGEN BALANCE OF A POLLUTED BROOK-POND SYSTEM DURING AN AERATION EXPERIMENT (VERANDERINGEN IN DE ZUURSTOFBALANS VAN EEN BEVUILD BEEK-VIJVERWATER GEDURENDE EEN AERATIE-EXPERIMENT),
Rijksuniversitair Centrum te Antwerpen (Belgium).
L. Maes.
Natuurwetenschappelijk Tijdschrift, Vol. 65, No. 1-3, p 52-74, January-June, 1983. 3 Fig, 7 Tab, 19 Ref.

Descriptors: *Water quality, *Aeration, *Streams, *Ponds, Biochemical oxygen demand, Chemical oxygen demand, Dissolved oxygen, Water pollution control, Organic matter.

A brook-pond system, polluted with domestic sewage, was aerated by the EVENS technique (previously called Phallus technique). During 3 years the evolution of oxygen concentration, of biochemical oxygen demand (BOD), of chemical oxygen demand (COD) and of oxygen producing capacity (OPP) was studied. In the overall change brought about by the aeration process, a direct and an indirect effect can be distinguished. In the aeration basin a strong reduction of BOD and COD takes place (direct effect). By this rapid removal of the organic load, a gradual recovery of the self-purification can take place. An important factor in self-purification is the increasing oxygen producing capacity of the water downstream (indirect effect). (Author's abstract)
W85-04889

CHANGES OF ORGANIC AND INORGANIC NITROGEN IN A POLLUTED BROOK-POND SYSTEM DURING AN AERATION EXPERIMENT (VERANDERINGEN IN DE ORGANISCHE EN ANORGANISCHE STIKSTOF VAN EEN BEVUILD BEEK-VIJVERWATER GEDURENDE EEN AERATIE-EXPERIMENT),
Rijksuniversitair Centrum te Antwerpen (Belgium).
L. Maes.
Natuurwetenschappelijk Tijdschrift, Vol. 65, No. 5, p 127-144, September-October, 1983. 3 Fig, 5 Tab, 13 Ref.

Descriptors: *Nitrogen, *Aeration, *Brooks, *Ponds, *Water pollution control, Organic nitrogen, Ammonia, Nitrites, Nitrates, Organic matter.

A brook-pond system, polluted with organic waste, was aerated by the EVENS techniques based on the principle of the water jet vacuum pump. During 3 years the evolution of ammonia, nitrite, nitrate and organic nitrogen was studied. In the aeration basin the decrease of ammonia and organic nitrogen was concomitant with the increase of nitrite and nitrate. In the downstream ponds a further decline of ammonia and organic nitrogen content was measured, but the nitrification process remained limited. From the aeration basin through the downstream sampling stations a gradual decrease in total N-concentration (NH4-N + NO2-N + NO3-N + org. N) was found. (Author's abstract)
W85-04890

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

MAINTENANCE OF DRINKING WATER QUALITY: THE ESSENTIAL DECISIONS,
For primary bibliographic entry see Field 5F.
W85-04449

RIVER BASIN PLANNING: PROBLEMS, OPPORTUNITIES AND IMPLICATIONS FOR ONTARIO CONSERVATION AUTHORITIES,
Waterloo Univ. (Ontario). Dept. of Geography.
B. Mitchell.
Canadian Water Resources Journal, Vol. 8, No. 1, p 1-20, 1983. 38 Ref.

Descriptors: *River basins, *Planning, *Ontario, *Watersheds, *Water resources development, River basin development, Mangement planning, Regional planning, Comprehensive planning.

Watershed or river basin planning is falling into disrepute because of a frequent failure to translate plans into action. Two strategic and two operational reasons account for this disenchantment. At a strategic level, it appears that comprehensive plans may not be required for all basins and adequate institutional arrangements do not exist to facilitate coordination of management functions and activities during both planning and implementation. At an operational level, thought is required regarding the implications of both longer and shorter periods

of time for watershed planning and implementation. Also, recommendations often are too numerous, ambiguous or abstract to help implementing agencies and thus frustrate the implementation process. Examples of these problems are presented from river basin management experiences across Canada. Their implications are reviewed for the ongoing development of watershed plans by each of the thirty-nine Ontario Conservation Authorities. While the drainage basin provides a sensible framework for planning, there should be flexibility to plan at other scales, depending upon the nature of the problems to be resolved. (Collier-IVI)
W85-04572

APPLES AND ORANGES: TOWARD A CRITIQUE OF PUBLIC PARTICIPATION IN GREAT LAKES DECISIONS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
A. P. Grima, and R. J. Mason.
Canadian Water Resources Journal, Vol. 8, No. 1, p 22-50, 1983. 2 Fig, 1 Tab, 48 Ref.

Descriptors: *Public participation, *Great Lakes, *Social participation, *Planning, Policy making, Public policy, Water quality management, Water resources development, Land use.

Better monitoring systems and public demands for rehabilitative action are focussing attention on the increasing stresses to the resources of the Great Lakes; consequently, the demand for public involvement in shaping the future of the Great Lakes will increase. Public participation covers a middle ground of all activities by individual citizens or groups attempting to influence public decisions. Effective lobbying and participation are desirable in order to ensure that as many competing views as possible are heard by the few elected or appointed policy makers. Within the strict terms of the 'market' democracy, public participation is justified in order to allow competition by as many interests as possible; biases should be identified and corrected to the extent possible. The state of the art does not permit development of a systematic prescription for evaluating participation programs, but this should not preclude a rigorous approach to the assessment of individual programs. Most attempts to develop a coherent framework for the evaluation of participation programs have incorporated the agency perspective on evaluation. Evaluations should consist of a carefully structured set of questions which have been formulated on the basis of the broad political considerations which are to be addressed. A case study evalution was made of the PLUARG (Pollution from Land Use Activities Group) public involvement program. As part of the PLUARG study, 17 public consultation panels (8 Canadian, 9 American) were established in 1977 to assist the Reference Group in determining practicable management strategies for control of pollution resulting from land use practices. The program was evaluated in terms of effectiveness, representatives of participants, interest of participants, public input to the final report, timing and accountability of the process. The analysis points to the risk of self-serving evaluations and to the need for ongoing and independent evaluations of public involvement programs. (Collier-IVI)
W85-04573

LINEAR PROGRAMMING MODEL FOR THE CONTROL OF COMBINED SEWER SYSTEMS WITH OFF-LINE STORAGE FACILITIES,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W85-04576

CANADIAN WATER MANAGEMENT: A ONE ARMED GIANT,
Canada Centre for Inland Waters, Burlington (Ontario).
D. M. Tate.
Canadian Water Resources Journal, Vol. 9. No. 3, p 1-5, November, 1984. 17 Ref.

Descriptors: *Canada, *Water resources development, *Management planning, *Water policy, *Economic aspects, Water supply development, Water quality management, Irrigation management, Water pollution control, Effluent charges, Planning, Municipal water.

Canada has pursued supply-oriented solutions to water development with uneven success. Often, well-intentioned efforts to increase water supplies have led to increased demands for water, and from there to a cycle of building, redevelopment, more demands and more building. Increased emphasis on water demand management in Canada is needed as a complementary strategy to the traditional water supply management approaches. The general water supply management approaches tend to undervalue or undervalue water resources; water is seen as a limitless resource and water systems are wasteful rather than economically efficient. The economic market is generally the principle resource allocation mechanism in Western societies and it would seem prudent to apply some of these principles to the task of water management. Examples are presented of demand management applications to municipal water supplies, irrigation water use, and industrial water use and effluent control. Economic solutions to pollution problems should be used in concert with other management possibilities. Economic instruments are potent tools for environmental good, and would add greatly to our ability to control environmental quality. It is the entry into the environmental control equation of economic measures, such as marginal cost pricing and other types of incentives, which offers the key to effective demand management. By focussing on rational water use, and socially beneficial reductions in water use or consumption, demand management identifies scarce resources which can be devoted to more economic use. Demand management is a prodevelopment strategy, in contrast to some perceptions that incorporation of demand management strategies would inhibit development; management of water demands is an integral component of a sustainable development strategy of economic advancement. (Collier-IVI)
W85-04685

ROLE OF PRICING IN MANAGING THE DEMAND FOR WATER,
Wilfrid Laurier Univ., Waterloo (Ontario).
F. W. Millerd.
Canadian Water Resources Journal, Vol. 9, No. 3, p 7-16, November, 1984. 2 Fig, 22 Ref.

Descriptors: *Pricing, *Economic aspects, *Water demand, *Management planning, *Public policy, Water policy, Water rationing, Marginal cost, Water rights, Water use.

Water pricing is rarely used to manage the demand for water. Since most water utilities operate on a requirements approach, adjusting supply to meet demand rather than adjusting demand to meet supply, it is probably inevitable that both demand management and pricing are largely ignored. Pricing will efficiently and effectively manage the demand for water. Marginal cost pricing which requires consumers to pay the costs of servicing them finds an ideal application in peak period pricing. Charging those responsible for the system capacity necessary to fulfill their peak demands is both efficient and equitable. Estimates of the price elasticity of demand for water and case studies both show that price increases will reduce the demand for water. Water rights are efficient as a demand management policy and is a possible substitute for pricing. Water use standards, although justified in many cases, may not always efficiently allocate water; standards do not provide incentives to conserve beyond the standard. Prices perform two essential roles in a market system: rationing and production motivation. Rationing is necessary since scarcity precludes both the satisfaction of all needs and the unlimited production of goods and services. Prices provide their production motivation role by indicating what consumers are willing to pay; producers react to this, directing thier production to those products most profitable to them. A perfectly operating market system will not only perform these functions but will achieve, from the viewpoint of society, the optimal level of output of any good or service. (Collier-IVI)
W85-04686

INTEGRATED PLANNING SYSTEM FOR HYDRO DEVELOPMENT IN ECUADOR,
Power and Water Systems Consultants, Oxon (England).
T. C. Muir, and J. Saavedra.
International Water Power and Dam Construction, Vol. 37, No. 1, p 20-24, January, 1985. 3 Fig, 2 Tab, 4 Ref.

Descriptors: *Water resources development, *Planning, *Hydroelectric power, *Ecuador, Economic aspects, Water management, Water resources development, Hydroelectric plants.

In 1979 the government of Ecuador approved a power sector development program which envisaged a reversal, by the late 1980s, of the existing 5%:75% ratio of hydro to thermal generation. An integrated planning system (SIP) was designed to achieve the rational long-term exploitation of the nation's estimated 93,000 MW of hydropower resources. Efforts in hydropower development planning are concentrated in three broad programs: micro hydropower, generally up to 5000 kW; mini hydropower, between 5 MW and 25 MW; and major hydropower projects, greater than 25 MW. A major effort in the implementation of SIP centers on development of a computer based information system containing historical and projected economic and financial data on the national economy and the electricity sector. This data provided economic scenarios for economic evaluation, preparation of demand forecasts and provided a basis for financial analysis of the total plan and the regional power companies. (Baker-IVI)
W85-04780

MATHEMATICAL MODEL FOR RESERVOIR SEDIMENTATION PLANNING,
Tippetts-Abbett-McCarthy-Stratton, New York.
P. C. Chao, and S. Ahmed.
International Water Power and Dam Contruction, Vol. 37, No. 1, p 45-50 and 52, January, 1985. 12 Fig, 2 Tab, 5 Ref.

Descriptors: *Mathematical models, *Reservoir silting, *Sedimentation, *Planning, Multipurpose reservoirs, Reservoir operation, Flood control, Computer models.

After examination of some of the existing well known multi-purpose reservoir projects in the world, it is felt that the general arrangement of their structures such as low level outlet, irrigation and power intake, could have been made differently, resulting in prolonged reservoir life and benefits. With the aid of mathematical modelling of the sediment distribution at the project planning stage, the reservoir capacity, operating rule, selection of the range of generating heads and flood control level can be more efficiently determined. The model would predict the growth of the delta, trap efficiencies, the rate of loss of live storage and the quantities and gradation of sediment that would discharge through the outlets. The benefits to any project can be maximized by varying the factors decribed. It is now possible to conduct such comparative reservoir sediment control studies with the computerized model. This tedious and time consuming computation for sediment distribution is otherwise always simply assumed or usually bypassed by planners, designers and owner/operators of the large water resources projects. (Baker-IVI)
W85-04785

THEORY OF FUZZY SUBSETS AND ITS APPLICATIONS TO WATER-RESOURCES PLANNING (DIE THEORIE UNSCHARFER TEILMENGEN UND IHRE ANWENDUNG IN DER WASSERWIRTSCHAFT),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Wasserbau und Wasserwirtschaft.
C. Rack.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 3, p 79-84, July, 1984. 3 Tab, 8 Ref.

Descriptors: *Planning, *Fuzzy set theory, Algorithms, Uncertainty, Water quality, Decision making, Elbe River.

Fields of application of the fuzzy set theory are discussed. Some basic properties of the young theory are introduced, ranging from the definition of a fuzzy subset through various operators to fuzzy relations. The paper illustrates applications of linguistic variables which are able to manage fuzzy algorithms, as these e.g. occur in the human language. The distinction between uncertainty and fuzziness is explained in a simple example. The examples of applicability are concerned with assessments of water quality, multipurpose decision making, as well as discharge and stage forecasts for the Elbe river. Attention is drawn to a few unsolved problems in applying the fuzzy set theory. (Author's abstract)
W85-04806

NITRATE CONTAMINATION: PUBLIC AWARENESS,
New York State Coll. of Human Ecology, Ithaca. Dept. of Design and Environmental Analysis.
For primary bibliographic entry see Field 5F.
W85-04828

ECONOMIC ANALYSIS OF WATER AND SANITATION ALTERNATIVES FOR COMMUNITIES IN NORTHERN CANADA,
J. J. Cameron.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 77-101, 10 Fig, 7 Tab, 7 Ref.

Descriptors: *Cost analysis, *Economic aspects, Sanitation, Municipal water, Water conveyance, Cold regions, Computer programs, Domestic water, Wastewater, Sewer systems.

An economic analysis of water and sanitation systems for northern communities is presented. A proper theoretical basis for the justification of expenditures on water and sanitation systems is the net present value of all benefits and costs. In the cost-effective approach the social desirability and benefits arising from water and sanitation improvements are left out of the computations. Instead, the analysis focuses on the determination of expenditures for each system alternative and presents these for comparison. The cost-effectiveness analysis should include all the costs associated with water and sanitation systems without regard for who pays for them. The methodology includes: planning horizon, discount rate, inflation, growth, staging, existing facilities, incremental cost, water and sanitation systems and assumptions, trucked systems, pipe systems, partial systems, and garbage service. A water and sanitation computer program was designed which included: program methodology and operation, program output, program assumptions and limitations. An analysis of water and sanitation alternatives for Fort McPherson, a Dene community of about 820 persons, located on the east bank of the Peel River, is presented. The objectives were to deliver a minimum of 90 L/person/day to each home and to remove sewage from the dwelling without handling. A study included: water supply alternatives, sewage treatment and disposal alternatives, water distribution and sewage collection alternatives of trucked system analysis and piped systems analysis. The partial system was seen to be the most cost-effective.
W85-04917

OPERATION AND MAINTENANCE CONSIDERATIONS FOR THE DESIGN OF ARCTIC WATER SYSTEMS,
Alaska Area Native Health Service, Anchorage.
M. W. Mauser.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 180-199, 4 Fig, 2 Tab.

Descriptors: *Design criteria, *Design standards, Municipal water, Costs, Analysis, Maintenance, *Alaska, Maintenance costs, Cold regions, Arctic regions, Operating costs, Reliability, Water treatment facilities, Utilities.

The design of arctic water systems with respect to operation and maintenance considerations is discussed. The design engineer makes decisions that will affect the water plant operator and the community for the life of the plant. In many small communities the job of operator is shared or there is a high turnover rate. The operator is the key to reliable service. The system needs to be easy to operate. Gauges and meters should be adequate and located where they can be easily read. The plant must be easy to maintain. In the event of a failure, it is important that the operator is alerted and instructed. The reliability of a system can be enhanced by using equipment and materials that are readily available or can be serviced locally or regionally. Salaries, heating, and pumping are the biggest expenses in operating a water plant. Designing a reliable, and easily operated and maintained plant automatically keeps salaries at a minimum. Provision should be made for the safe storage and handling of chemicals. An idealized schematic is presented to make plant operation and maintenance easier and reduce piping losses in a circulating water system. After the initial design is completed, it should be reviewed by the operator, sanitarians, and maintenance specialists. Operation and maintenance is for the life of the plant. Shortcuts or oversights in design that may seem minor at first glance can be very important to the operator and the community.
W85-04923

HEATING ENCLOSED WASTEWATER TREATMENT FACILITIES WITH HEAT PUMPS,
Cold Regions Research and Engineering Lab., Hanover, NH.
C. J. Martel, and G. Phetteplace.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 262-280, 7 Fig, 6 Tab, 13 Ref.

Descriptors: *Wastewater facilities, *Heating, Management planning, Construction, Water reuse, Effluents, Fouling, Heat pump.

A simple procedure for evaluating the technical and economic feasibility of installing a heat pump at new or existing wastewater treatment facilities is presented. Existing heat pump installations are in Fairbanks, Alaska; Wilton, Maine; and Madison, Wisconsin. The heat pump in each of these plants is supplied with wastewater of secondary effluent quality or better. A higher strength wastewater is not used because of possible solids accumulation and fouling problems on the interior surfaces of the tube heat exchanger. The preferred location for the intake to the heat pump is just upstream of the overflow weir in the chlorine contact chamber. A heat pump is a cyclic device which transfers heat from a lower temperature source (effluent) to a higher temperature sink (hot water heating system). The coefficient of performance (COP), an important factor in determining the economic feasibility of installing a heat pump, depends mainly on the temperature difference between the heat source (wastewater effluent) and the heat delivery system. The greater the temperature difference, the lower the COP. To maintain a high COP it is better to provide a greater flow through the evaporator and drop the temperature of the effluent only a few degress than to provide a low flow and a large temperature drop. The most important step in sizing a heat pump is to estimate the building heating load resulting from basic conduction losses through walls, windows, ceiling and floor, and air infiltration and ventilation losses. The effluent flow rate needed to supply the evaporator will depend on the heat pump capacity, COP, and the temperature drop across the evaporator.
W85-04924

UNDERGROUND UTILITIES IN BARROW, ALASKA,
Moolin (Frank) and Associates, Anchorage, AL.
J. L. Cerutti, W. L. Zirjacks, C. T. Hwang, and D. E. Bruggers.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 358-382, 19 Fig, 4 Ref.

Descriptors: *Underground structures, *Underground waste disposal, Utilities, Construction, *Alaska, Cold regions, Artic regions, Design criteria, Wastewater treatment.

Barrow, Alaska, the northern-most community in the United States, currently has no area-wide piped water or sewerage facilities. After evaluating the recommendations, design parameters, and risks, the North Slope Borough decided upon a complete below ground utilidor system. The system has the highest capital cost and the lowest maintenance cost of all the systems evaluated. It provides the greatest flexibility for further expansion of the utility system and offers the best aesthetics of all systems investigated. The utilidor is designed to contain water, sewerage, electrical, cable T.V., and telephone transmission systems. The interior will be kept above freezing with heated, circulating water, and space will be provided for man access for maintenance. To evaluate construction techniques and verify the thermal design parameters, part of the utilidor was isolated and instrumented as a test section in May of 1981. All methods of excavation were successful in producing a trench; however the trench portions that were excavated by blasting without the benefit of bordering Roscaw cuts, resulted in an oversize trench. The void space in the dried sands used in the backfill transmitted water much more freely than expected. The ground temperatures adjacent to the heated portion were not significantly affected by the increase of the utilidor temperature. The performance of the test section in obtaining freeze-back after its installation during the start of the seasonal warming cycle indicates that the original design parameters are valid.
W85-04925

CASE STUDY, POTABLE WATER RESERVOIR, TUKTOYAKTUK, NORTHWEST TERRITORIES,
Government of the Northwest Territories, Yellowknife. Water and Sanitation Section.
B. Milburn, D. Clark, N. Jacobsen, B. Smith, and S. Brown.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environment Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 401-419, 2 Fig, 13 Ref.

Descriptors: *Potable water, *Reservoirs, Cost analysis, Environmental effects, Cold regions, Dredging, Water supply, Salinity, Sediment transport, Bathymetry, Pollutants, Benthos, Food chains, Turbidity, Overflow, Case studies.

A case study of potable water reservoir in Tuktoyaktuk, N.W.T. is presented. The predesign study took into account the availability of dredging equipment and subsequently determined that the reservoir site could be established prior to source identification. Three major water supply system concepts, based on the general location of the water source, were identified early in the study: Across the Harbour Concept (i.e., water crossing); Southern Lakes Concept (all overland routes); and Tuktoyaktuk Harbour Concept (direct withdrawal). A cost-effective analysis methodolgy was applied to all alternatives to determine the water supply system that will supply the long term demand for water at the minimum level of service. The concept of drawing water from Tuktoyaktuk Harbour in the winter was rejected because of the basic conflict and resultant pollution potential in harbor utilization, with the shipping due primarily to oil and gas exploration activity in Tuk and in the Beaufort Sea. The geotechnical considerations included: subsurface investigation, reservoir liner, side slopes, liner cover, sub-drainage, and overflow protection. Environmental concerns included: turbidity, temperature and salinity, sediment transportation and deposition, alteration in local bathymetry, potential chemical effects, mobilization of contaminants, dissolved oxygen, potential biological effects, fish entrainment, alterations to migratory

patterns, impact in benthic populations, and impact on food resource chain. The reservoir was sized to meet an annual potable water requirement of 90,000 cu m based on projected populations and water consumption for a 20-year design life.
W85-04927

PRIVATIZATION NEEDS THE PROFESSIONAL APPROACH,
Pirnie (Malcolm), Inc., White Plains, NY.
G. P. Westerhoff.
Water Engineering and Management, Vol. 132, No. 2, p 25-28, February, 1985. 4 Fig.

Descriptors: *Economic aspects, *Wastewater treatment facilities, *Water treatment facilities, *Privatization, Engineering, Education, Training.

As federal support erodes, funding needed for continuing construction of water/wastewater facilities is going to have to be provided by other means. One of these means is privatization which requires an understanding and carefully planned management. Under privatization a facility such as a solid waste, water, or wastewater plant is typically financed using tax exempt industrial development bonds. The largest cost savings are realized when the private service party has access to tax-free financing such as these bonds for financing the project. Four principal reasons why municipal agencies are considering privatization are: inability to raise capital, tax incentive advantages, greater private sector efficiency, and the transfer of risk. A privatization project includes three major technical elements: fiscal, engineering and legal. From a municipal agency's perspective, the key to a successful privatization project is the right combination of ensuring maximum gain from the potential financial benefits and the minimization of the potential disadvantage of loss of control. These can be obtained when the municipal agency fully understands the privatization process, the RFP is carefully prepared and a contract is negotiated which is fair to both parties and clearly defines the service being contracted. (Baker-IVI)
W85-04954

6B. Evaluation Process

ROLE OF WATERSHED MANAGEMENT IN WATER RESOURCES DEVELOPMENT PLANNING - NEED FOR INTEGRATED APPROACH TO DEVELOPMENT OF CATCHMENT AND COMMAND OF IRRIGATION PROJECTS,
Government of Bihar, Patna (India).
B. Sinha.
Water International, Vol. 9, No. 4, p 158-160, December, 1984.

Descriptors: *Watershed management, *Planning, *Water resources development, Reservoirs, Siltation, Decision making, Water management, Erosion.

Deficiencies common in the management of watersheds are identified and the need for dove-tailing watershed management plans and programs with the comprehensive water resources planning framework is highlighted. Observations on many existing reservoirs have shown that the rate of actual siltation is much higher than what was assumed in the design; and sedimentation is not confined to the space below the dead storage level as was assumed and provided for in the design. Variations in the rate of siltation and pattern of distribution in the reservoir may be attributed to inadequacy and inaccuracy of observed data available for use in design; deficient design and planning assumptions and practices; increase in soil erosion in the catchment; faulty and/or inappropriate operation of the reservoir; and slippage in the program of implementation of projects planned for concurrent execution under a unified comprehensive multi-reservoir system. Some of the main causes of the high rate of siltation and its distribution pattern over the depth of reservoirs could substantially, if not wholly, be eliminated by improving the system of silt data collection, collation and analysis; by modifying design and regulation practices; and by drawing up realistic implementation schedules for projects of an interdependent and interacting nature. The lack of a comprehensive approach in the planning of water resources development projects treating a river basin as a unit of planning has been a major problem. (Baker-IVI)
W85-04441

USE OF PERFORMANCE INDICATORS IN SEWAGE TREATMENT APPRAISAL,
Yorkshire Water Authority (England).
For primary bibliographic entry see Field 5D.
W85-04510

COST-EFFECTIVE MANAGEMENT - REVENUE AND TECHNICAL MONITORING,
Anglian Water Authority, Northampton (England). Northampton Sewage Div.
M. J. Johnson, and G. Nunn.
Water Pollution Control, Vol. 82, No. 2, p 203-212, 1983. 1 Fig, 1 Tab, 1 Ref.

Descriptors: *Management, *Cost analysis, Economic aspects, Decision making, Planning, Operation, Monitoring.

Cost-effective management is a management style, a way of thinking, which must permeate through the whole of an organization if it is to be fully cost-effective. Routine revenue and technical monitoring in the form of regular planned collection, processing and production of information for management is only a part of the process. A manager who wishes to be fully cost-effective must be aided by such routine information, but not confined by it. Managers must look for and anticipate change, be prepared to question current methods and indeed the need for the whole or the part of a task. They must be outward looking and attempt to monitor the environment in which the organization functions so that external changes can be anticipated and accommodated. Setting the budget, routine financial and technical control, performance monitoring and performance indicators, the role of the Ad Hoc investigation, and management of change are specifically discussed. (Baker-IVI)
W85-04519

METHODOLOGY FOR POLLUTION CONTROL DECISION ANALYSIS,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W85-04582

LOW-HEAD HYDROPOWER FOR LOCAL USE,
Michigan State Univ., East Lansing.
P. Kakela, G. Chilson, and W. Patric.
Environment, Vol. 27, No. 1, p 31-38, January/February, 1985. 5 Fig, 12 Ref.

Descriptors: *Hydroelectric power, *Low-head, *Dam construction, *Michigan, Reconstruction, Regulations, Planning, Water resources development.

Low-head hydropower represents a unique, valuable resource for many local communities. At hydro facilities, the amount of energy that can be generated depends on two factors: the volume of water (flow) and the vertical distance the water falls (head). Many states, such as Michigan, have plenty of water but simply lack mountains. Seasonal fluctuations of rainfall and snowmelt are also important factors. The holding capacity of most watersheds not yet developed for hydropower is also relatively small and in many cases may have been reduced even more by extensive urban development. It is important to recognize that even a limited hydro potential can provide a valuable, clean, renewable energy source, especially at the local level. Many regulations control the development of dormant water power potential. Hydropower comes under both state and federal regulations because most streams are considered interstate navigable waterways. There are at least 17 laws at the federal level and, in Michigan, there are 10 state statutes that might be involved to directly or indirectly influence hydro developments. (Baker-IVI)
W85-04620

PROPOSED FRAMEWORK FOR DEVELOPING A MULTIDISCIPLINARY WETLANDS VALUATION MODEL,
North Dakota State Univ., Fargo. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 2L.
W85-04684

NEW IDEAS RESHAPING TREATMENT TECHNOLOGIES,
Lorenz (William T.) and Co., Boston, MA.
For primary bibliographic entry see Field 5D.
W85-04751

IMPORTANCE OF SAMPLE DISCRIMINATION IN USING THE TRAVEL COST METHOD TO ESTIMATE THE BENEFITS OF IMPROVED WATER QUALITY,
Pennsylvania State Univ., University Park. Dept. of Agricultural Economics and Rural Sociology.
M. O. Ribaudo, and D. J. Epp.
Land Economics, Vol. 60, No. 4, p 397-403, November, 1984. 1 Fig, 13 Ref.

Descriptors: *Evaluation, *Recreation, *Travel cost method, *Water quality, *Lake Champlain, Economic aspects, Sampling, Social aspects.

The travel cost method is a widely used technique for the valuation of recreation sites in the absence of organized markets. The problem is to be certain that both current users and former users are included in the survey for the travel cost method. A study was conducted in the northeastern portion of Lake Champlain during the summer of 1982, using personal interviews of randomly selected recreationists at recreation sites. Interviews were conducted at St. Albans Bay, alternative sites, and on the open lake itself. Respondents who had recreational experience with St. Albans Bay were asked to imagine that the bay would become as clean as other parts of the lake with which they were familiar. The improvement of water quality in the Bay appears to be desirable for recreationists. Substantial benefits for both current and former users would be generated. Results tend to support the sampling approach used and the subsequent application of the travel cost model. Statistical tests on the sample population indicate significant differences in most of the relevant socioeconomic and recreation behavior variables tested. The estimated benefits for each group are significantly different from each other. The estimate for aggregate benefits is more accurate than if only current users had been included. (Baker-IVI)
W85-04753

OPPORTUNITY COSTS OF PRESERVING COASTAL WETLANDS: A CASE STUDY OF A RECREATIONAL HOUSING DEVELOPMENT,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Economics.
S. S. Batie, and C. C. Mabbs-Zeno.
Land Economics, Vol. 61, No. 1, p 1-9, February, 1985. 3 Fig, 2 Tab, 17 Ref.

Descriptors: *Wetlands, *Environmental effects, *Land development, *Housing, *Virginia, Evaluation, Coastal areas, Recreation, Economic aspects, Permits.

A case study is presented of the development value of converting coastal wetlands into recreational housing lots at Captain's Cove subdivision on Virginia's Eastern Shore. The development value estimates are valid measures of the opportunity cost of prohibiting recreational development in order to preserve Captain's Cove wetlands. The state of hydrological and biological assessment of natural wetlands frequently is not of sufficient detail nor of proper design for use in economic valuation of specific wetlands sites. In contrast, economists are able to supply estimates of development value. The use of the development valuation framework for the provision of development value estimation appears to have considerable utility when data is

lacking for a complete analysis of all social cost and benefits of natural resource use decisions. The analysis of net marginal returns to wetlands as illustrated at the Captain's Cove site reveals several effects of allowing various levels of wetlands destruction. If is were reasonable to assume that the denial of a permit to develop Captain's Cove would mean no investment would be made, then the total returns foregone because of permit denial could be high. If a wetlands board focused on these returns, it is likely that the permit would be allowed unless very substantial negative externalities from development were identified. (Baker-IVI)
W85-04754

FUTURE OF HYDROPOWER IN BRAZIL,
A. C. T. Holtz.
International Water Power and Dam Construction, Vol. 37, No. 1, p 16-19, January, 1985. 2 Fig, 6 Tab, 6 Ref.

Descriptors: *Water resources development, *Brazil, *Hydroelectric power, Water management, Planning, Decision making, Dam construction, Electrical transmission.

Brazil's hydroelectric potential allows for the installation of up to 213000 MW, of which only 24% is currently in operation or under construction. The promising outlook for developing this potential is examined. Brazilian hydroelectric potential exceeds by 80% the total consumption of primary energy of all types recorded in Brazil in 1983. The largest portion of the potential still available is located in the North/Central West and South, especially in the North, where roughly 97800 MW remain to be developed. Progress made locally in the technology of long-distance electric energy transmission has made it economically feasible to set up, in the relatively near future, a single interconnected system for all Brazil, which would enable the country to anticipate development of the northern potential to the benefit of other regions. Preserving the environment, or at least minimizing negative ecological effects, has played an increasingly important role in the selection of different sources of power supply and is likely to become a major conditioning factor for the energy model to be adopted in the future. (Baker-IVI)
W85-04779

ACID DEPOSITION CONTROL, A BENEFIT-COST ANALYSIS: ITS PROSPECTS AND LIMITS,
Wyoming Univ., Laramie. Dept. of Economics.
T. D. Crocker, and J. L. Regens.
Environmental Science and Technology, Vol. 19, No. 2, p 112-116, 1985. 2 Tab, 18 Ref.

Descriptors: *Cost-benefit analysis, *Acid deposition, *Water pollotion control, Economic aspects, Precipitation chemistry, Acid rain, Policy making.

Benefit-cost analysis is a potentially useful component of policy evaluation whose utility is constrained by the availability of reliable data. Precipitation chemistry data indicate that the geographic scope of acid deposition covers most of eastern North America. A benefit-cost analysis of acid deposition requires three kinds of information: the differential changes across space and time that acid deposition control causes in people's alternative opportunities to produce and consume, the responses of prices to these changes, and the adaptations emitters and receptors can make to these changes in opportunities and prices. Accounting for the results of the last two facets is the economic analysis portion of benefit-cost analysis. The value of benefit-cost analysis of acid deposition control resides more in its potential contributions to clearer statements of the problem than in its provision of accounts for social and ecological bookkeeping. Such analyses force policy makers to face the inherent tradeoffs of the acid deposition problem and the influences that individuals and institutions choose to exercise on the structure of these tradeoffs. (Baker-IVI)
W85-04798

MEASUREMENTS AND ESTIMATION IN HYDROLOGY - IDEAS AND PROPOSALS FOR THE QUANTIFICATION OF ERRORS AND UNCERTAINTIES (MESSUNGEN UND SCHATZUNGEN IN DER HYDROLOGIE - GEDANKEN UND VORSCHLAGE ZUR QUANTIFIZIERUNG DER FEHLER UND UNSICHERHEITEN),
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 7B.
W85-04805

STATUS OF SANITATION FACILITIES IN ALASKA - 1982,
OTT Water Engineers, Anchorage, AK.
W. L. Ryan.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 18-24, 1 Tab.

Descriptors: *Utilities, *Cold regions, Sanitation, Polar regions, *Alaska, Domestic water, Domestic wastes, Wastewater.

A complete inventory of the Alaska Native communities in which sanitation facilities have been installed by the federal and/or state governments is presented. If one considers running water with flush toilets in each house as the goal, there are still around 9000 families that need facilities or major improvements and/or expansion of their existing facilities. However, there are about 70 communities where running water in the house will never be feasible because of engineering or construction constraints. Sixty of these would probably be provided with a central facility. The other ten would likely never be provided with any type of facilities other than a central watering point, primarily because of their small size. This equates to an unmet need of some $280 million (U.S.). This need is split among water supply, sewage disposal, and solid waste disposal on the basis of 55, 41, and 4 percent, respectively.
W85-04915

UTILITIES DELIVERY FOR THE INDIAN AND INUIT AFFAIRS PROGRAM,
Department of Indian Affairs and Northern Development, Ottawa (Ontario). Municipal Services Div.
J. R. Benner, and S. Lam.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 25-70, 22 Fig.

Descriptors: *Utilities, *Cold regions, Polar regions, Sanitation, Water delivery, Sewer systems, Indians, Domestic water, Potable water, Wastewater, Capital costs.

An overview of utilities delivery activities within the Indian and Inuit Affairs Program of the Department of Indian Affairs and Northern Development is presented. All domestic water systems shall provide potable water of a quality stated in the Canadian Drinking Water Standards and Objectives, 1968; there are four levels: the individual is responsible for locating, transporting and treating, if necessary, his water supply; a community water system with one or more watering points from which residents can obtain potable water; potable water is delivered by vehicle to individual residences in limited quantities; and pressurized potable water is provided to meet all normal residential requirements. There are three levels for sewage disposal: the individual is responsible for disposal of human wastes and wastewater from his residence; removal and disposal of limited quantities of domestic sewage is provided; and removal and disposal of all domestic sewage from residences is provided. Capital expenditures for utilities infrastructure has increased steadily over the past 15 years. Generally speaking, the southern reserves are better equipped with water supply and sewage disposal facilities than the northern ones due to various factors including availability of good water sources, accessibility and proximity to urban centers. The majority of the northern reserves are without proper water supply and sewage disposal facilities. In planning and designing a water supply and sewage disposal system for an Indian reserve, life style and community must be considered.
W85-04916

WATER CONSERVATION IN BARROW, ALASKA,
Northern Testing Lab., Inc., Fairbanks, AK.
M. R. Pollen, and D. W. Smith.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 102-109, 2 Fig, 1 Tab, 3 Ref.

Descriptors: *Water conservation, *Water costs, Water use, Wastewater collection, Cold regions, *Alaska, Underground structures, Water treatment facilities.

The operation and maintenance history of water conservation systems in use in the community of Barrow, Alaska are described. An underground utilidor system is under construction which will provide community wide water distribution and wastewater collection for the first time. The transition from the water conservation technology to the full service utility system is examined. The primary water supply for the community is a centrally located impounded reservoir comprised of a series of shallow overflow dams. Due to high color, turbidity, iron, and total dissolved solids (TDS) the water is processed through aeration, coagulation, sedimenation, filtration, and reverse osmosis treatment. The present cost of delivered water ranges from 2.6 to 4.0 cents per liter. Future delivered cost is unknown at the present time, but will reflect both the cost of treating the water and the operation and maintenance of the utilidor. A study of the water consumption rates by the residents of Barrow was completed in 1981. Three levels of water consumption were: trucked residential at 34 L/person/day, Browerville Addition at 49 L/person/day, and Hospital/School at 117-220 L/person/day. The systems using different grades of water include: hospital/school complex split raw and potable water system; Browerville addition redux grey water recycling plant; and Top of the World Hotel Met Pro grey water recycling plant. The systems that do not use water include: aqua sans mineral oil flush system, compost toilets, and incinerating toilets. Minimal water use equipment includes low flush toilets and vacuum flush systems. The high cost of water has resulted in the installation of major water conserving systems.
W85-04918

SMALL HYDRO IN CHINA: PROGRESS AND PROSPECTS,
Ministry of Water Resources and Electric Power, Beijing (China). Dept. of Rural Electrification.
B. Deng.
International Water Power and Dam Construction, Vol. 37, No. 2, p 15-17, February, 1985.

Descriptors: *Hydroelectric power, *Small hydropower, *China (Peoples Republic), Construction, Power plants, Planning.

During the 1950s emphasis was placed on hydropower stations as a part of the rural agricultural resources development movement and by 1966, 8983 stations had been built with an installed capacity of 238 MW. This period was characterized by slow construction, small installed capacity per station, and simple construction of not very high quality. In 1969 the first national conference on small hydro power (SHP) was held to develop a national plan and discuss ways of effectively resolving problems in construction. The end of the 1970s and early 1980s saw the most rapid development of SHP in China. By the end of 1983 there were 76,000 SHP stations with an installed capacity of 8500 MW and annual generation of 20000 GWh. The scope of China's SHP includes two components: stations, and small local grids where SHP forms the main source of local electricity supply. With the support of the State, it is planned that SHP electricity generation should rely on the

pooled resources of county, rural districts, villages and individuals. (Baker-IVI)
W85-04947

EXPLOITING SEASONAL ENERGY FROM SMALL HYDROPOWER STATIONS,
Ministry of Water Resources and Electric Power, Beijing (China). Dept. of Rural Electrification.
Y. Li.
International Water Power and Dam Construction, Vol. 37, No. 2, p 17-18, February, 1985. 1 Fig, 3 Tab.

Descriptors: *Hydroelectric power, *Seasonal variation, *China (Peoples Republic), *Small hydropower, Energy, Hydroelectric plants, Industrial production, Agricultural engineering.

Several ways to use seasonal energy fully have been developed in the Peoples Republic of China. These include: seasonal energy for industrial consumers, seasonal energy for agricultural processing, and seasonal energy for rural domestic purposes. In Dehua county, Fujian province, there are 237 small hydro power (SHP) stations with a total installed capacity of 14.6 MW and an annual average design energy output of 5.9 times 10 to the 7th power kWh. The stations are all run of river type and operate in three independent small grids. In Xinchang county, in Zhejiang province, in the agricultural area, 215 SHP stations exist with a total installed capacity of 27 MW. In the area of domestic use, since 1981, electricity for cooking has begun to be supplied experimentally from SH grids. In order to encourage rural households to use electricity, the policy of preferential pricing during the flood season is adopted. Also, in an effort to encourage electricity usage, high efficiency electric cookers are advocated. (Baker-IVI)
W85-04948

ROLE OF SMALL HYDRO IN RURAL ELECTRIFICATION,
Ministry of Water Resources and Electric Power, Beijing (China). Dept. of Rural Electrification.
L. Bai.
International Water Power and Dam Construction, Vol. 37, No. 2, p 19-20, February, 1985.

Descriptors: *Hydroelectric plants, *China (Peoples Republic), *Small hydropower, *Evaluation, Agricultural engineering, Water resources development.

At the beginning of 1984 the government of the Peoples Republic of China issued a directive to make full use of the rich resources in small hydropower (SHP), to build a Chinese style rural electrification system to make electricity available for cooking, boiling, lighting, cooling, processing, culture, education, county-run enterprises and agricultural oriented needs in a number of counties by the end of 1990. Within five years there should be 100 counties using SHP in prototype arrangements. It is estimated that about half of the counties can exploit their own small hydro resources to meet their own needs. Preliminary aims of the current program are that electricity should be available to over 90% of the families in each pilot county. Electricity should be used by more than 20% of the families for more than 6 months yearly for cooking, boiling water and baking, thus replacing the use of wood. More than 90% of the families should be able to use electricity for agricultural processing. Electricity should be used for small scale irrigation and other agricultural needs. Power needs of the enterprises run by counties or townships should be generally met. The economic evaluation of SHP consists of three parts: analysis of the social benefit, the commercial benefit and the local benefit. (Baker-IVI)
W85-04949

LARGE HYDROPOWER STATIONS IN CHINA,
Scientific and Technological Information Inst., Bejing (China).
X. Wu.
International Water Power and Dam Construction, Vol. 37, No. 2, p 37-39, February, 1985. 2 Fig.

Descriptors: *Hydroelectric power, *Yangtze River, *Wujiang River, *China (Peoples Republic), *Water resources development, Planning, Construction, Rivers.

China has numerous rivers with an abundance of hydropower resources. The Yangtze river ranks the first in hydropower resources, having an installable potential of 197 GW with an annual energy output of 1027 TWh, constituting 53.4% of the total. At present 133 hydropower stations with an installed capacity greater than 12 MW have been built, and 43 of such a size are under construction. Of the principal sources of energy in China, coal, hydroelectricity, oil and natural gas, China's richest is hydropower potential. At present the focus is centered on developing further the hydropower resources in the upper reaches of the Yellow river, the upper and middle reaches of the Yangtze river and its tributaries, the Hongshui river and the Lancang river. A tentative planning proposal is that by the year 2000 the newly increased hydropower installed capacity will be 60 GW including small hydro, and the total hydropower installed capacity will rise to 90 GW and the annual hydroelectric energy output would amount to 250 TWh. (Baker-IVI)
W85-04951

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

PRIVATE AND SOCIAL COST - BENEFIT PERSPECTIVES AND A CASE APPLICATION ON RESERVOIR SEDIMENTATION MANAGEMENT,
Ohio State Univ., Columbus. Dept. of Agricultural Economics and Rural Sociology.
For primary bibliographic entry see Field 4D.
W85-04447

INCREASING INTEREST OF PUBLIC ELECTRICITY SUPPLIERS IN MICRO POWER PLANTS (AUFLEBEN KLEINER WASSERKRAFTE AUCH BEIM OFFENTLICHEN ELEKTRIZITATSVERSORGUNGSUNTERNEHMEN),
Stadtwerke Pforzheim (Germany, F.R.).
R. Dupont.
Wasserwirtschaft, Vol. 74, No. 12, p 571-574, December, 1984. 3 Fig, 6 Ref.

Descriptors: *Small hydropower, *Hydroelectric plants, Utilities, Hydroelectric power, Economic aspects, Construction.

The interest in hydro power generation is increasing to a high degree. Public electricity suppliers engaged in generating and distributing electric power and running their own water power plants are stimulated to renew and improve old plants or to build new ones. The economical and technical aspects of a recently materialized project demonstrate the measures to be taken and the profit expected of a water plant. The experiences described refer to run-of-river water power stations up to 1 MW. (Author's abstract)
W85-04628

PEAK USE CHARGE: AN EQUITABLE APPROACH TO CHARGING FOR AND/OR REDUCING SUMMER PEAK USE,
Fairfax County Water Authority, Merrifield, VA.
F. P. Griffith, Jr.
Canadian Water Resources Journal, Vol. 9, No. 3, p 17-21, November, 1984. 2 Append.

Descriptors: *Fairfax County, *Virginia, *Pricing, *Water use, *Economic aspects, Peak demand, Water conservation, Water policy, Management policy, Policy, Metropolitan water management.

Fairfax County Water Authority (Authority), serving a population of over 670,000 in the northern Virginia suburbs of Washington, D.C., was one of the first (1974) utilities in the United States to utilize a water rate structure as a significant segment of a water management policy. The Authority has a basic philosophy and objective of obtaining economic equity and practical conservation. The Authority had a multitude of considerations for the design and actual derivation of a new rate structure. The review and analysis of existing standard and conservation rate schedules were a part of those considerations. The Authority eventually adopted a 'peak use charge' rate system whereby each individual customer is assessed a surcharge per 1,000 gallons during the two peak demand quarters for their use that exceeds their winter quarter use by more than 30 percent. The Authority had reasoned that by directing the elasticity of pricing at the special summer usage activities, it could possibly derive the most benefit relative to reducing the peak demands. To date, after nearly 10 years since adopting the peak use charge, the Authority has concluded that it has attained its objectives and can live with this charge despite the obvious problems and controversy. (Author's abstract)
W85-04687

EMPIRICAL BASIS FOR MUNICIPAL WATER RATES MODIFICATION,
Toronto Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 3D.
W85-04688

EFFECTS OF ELECTRICITY RATES AND RATE STRUCTURES ON PUMP IRRIGATION: AN EASTERN COLORADO CASE STUDY,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 3F.
W85-04752

COST SHARING IN A MULTIPURPOSE WATER PROJECT,
Department of the Environment, London (England).
P. T. McIntosh, and M. C. D. La Touche.
International Water Power and Dam Construction, Vol. 37, No. 1, p 13-15, January, 1985. 3 Fig, 1 Tab.

Descriptors: *Cost sharing, *Multipurpose projects, *Mantaro Transfer Project, *Peru, Water resources development, Planning, Water management, Economic aspects, Political aspects.

Cost sharing is a matter for negotiation. Because of this and because political and other factors may influence the outcome, lengthy calculations may not be justified. The simplified analysis described and illustrated in relation to the Mantaro transfer project, while not indicating any final and precise results, indicates the range within which it would be reasonable for the finally agreed division of costs to fall. Two guidelines to consider in deciding how to share the cost of a joint project are: the most any participant would be prepared to pay would be the cost of an equivalent single purpose project; and the least each participant would expect to pay is his separable costs within the joint project (that is, those that are clearly in no way related to the other products). (Baker-IVI)
W85-04778

6D. Water Demand

GARRISON DIVERSION UNIT - AN UPDATE,
Brandon Univ. (Manitoba). Dept. of Geography.
For primary bibliographic entry see Field 4A.
W85-04574

INCREASING INTEREST OF PUBLIC ELECTRICITY SUPPLIERS IN MICRO POWER PLANTS (AUFLEBEN KLEINER WASSERKRAFTE AUCH BEIM OFFENTLICHEN ELEKTRIZITATSVERSORGUNGSUNTERNEHMEN),
Stadtwerke Pforzheim (Germany, F.R.).
For primary bibliographic entry see Field 6C.
W85-04628

ARIZONA WATER ISSUES: CONTRASTING ECONOMIC AND LEGAL PERSPECTIVES,
Streich, Lang, Weeks and Cardon, Tucson, AZ.

For primary bibliographic entry see Field 6E.
W85-04756

ACCEPTANCE OF TREATED WATER BY NORTHERN COMMUNITY RESIDENTS,
Government of the Northwest Territories, Yellowknife. Town Planning and Lands Div.
M. J. Sima.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 140-151, 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Treated water, *Water conveyance, Water storage, Water tanks, Domestic water, *Canada, Water use, Cold regions, Chlorination, Potable water, Reservoirs, Education, Public policy.

The Government of the Northwest Territories, through its Water and Sanitation Program, establishes basic water supply facilities in the Northwest Territories to ensure that all residents have year-round access to water that will meet reasonable health and sanitation standards. The complexity of the facilities varies from community to community with the minimum acceptable water supply structure being considered a pumphouse/truckfill station. In some of the communities where new facilities have been installed, it has been found that the native people use the treated water for general household use only. Although the water supply meets all the the requirements, some people do not like the taste of treated water and still haul and melt ice and snow for drinking water and for making tea. Case examples of taste problems are given for Lake Harbour, N.T.W.; Sanikiluaq, N.W.T.; and Eskimo Point. The possible reasons for complaints include: the relative newness of the facilities, the lack of experience of the operators especially in respect to the quantity of chlorine to be added; the use of aluminum tanks; the sensitivity to taste of the Inuits; and the traditional background of using pristine waters for their water supplies interferes with the use of water from constructed reservoirs. Some approaches to minimize complaints include: a more detailed sampling of water sources during the predesign stage; training of the operator in chlorine dosage control; design of individual storage tanks to minimize corrosion; and the development of a public education and awareness program on water treatment.
W85-04921

6E. Water Law and Institutions

INTERNATIONAL WATER MANAGEMENT IN CANADIAN-AMERICAN RELATIONS, 1894-1907,
Royal Military Coll. of Canada, Kingston (Ontario).
N. F. Dreisziger.
Canadian Water Resources Journal, Vol. 8, No. 3, p 58-76, 1983. 18 Ref.

Descriptors: *Water management, *International law, *Canada, *United States, International agreements, Water resources development, History.

Until the first decade of the twentieth century Canada and the United States did not possess a set of comprehensive regulations for international water management along their common frontier. The need for such regulations arose during the 1890s and the early 1900s when accelerating population growth, industrialization and technological change resulted in new uses of waters along the U.S. - Canada international boundary. The proliferation of such uses threatened water management in the two countries with chaos. The threat was recognized by technical experts and was dealt with by the governments in Washington and Ottawa -- after innumerable delays. In the end comprehensive guidelines were agreed upon for the orderly development and preservation of common water resources. In 1909 they were incorporated into a treaty, providing North America with its first body of international law for international water management. (Author's abstract)
W85-04588

LOW-HEAD HYDROPOWER FOR LOCAL USE,
Michigan State Univ., East Lansing.
For primary bibliographic entry see Field 6B.
W85-04620

ARIZONA WATER ISSUES: CONTRASTING ECONOMIC AND LEGAL PERSPECTIVES,
Streich, Lang, Weeks and Cardon, Tucson, AZ.
M. F. McNulty, and G. C. Woodard.
Arizona Review, Vol. 32, No. 2, p 1-13, Fall, 1984. 2 Fig, 2 Tab.

Descriptors: *Water conservation, *Legal aspects, *Economic aspects, *Arizona, Water management, Water rights, Regulations, Planning, Water demand.

Unsettled water issues in Arizona are reviewed from different perspectives - from the perspective of the resource economist, whose standard of performance usually is maximizing economic efficiency via minimizing constraints upon free trade; and from the perspective of the water law attorney, who is interested in protecting existing property rights and securing future expectations, and who often is more concerned with equity than efficiency. The overall goal of water resource management in Arizona is to assure a stable, long-term water supply adequate to support the demands of the state's burgeoning population and industrial base. Conservation plans promulgated for the state's Active Management Areas are the first in a series of four such plans designed to move the state toward balancing water supply and demand by the year 2025. Before writing the first plans, an inventory was made and certified for all existing uses of water. This process of verifying grandfathered water rights provided a necessary data base for statewide water management and legitimized current uses of water. Nearly 17,000 people applied for certificates of grandfathered rights in September of 1981. The care with which these applications are being processed speaks well for the future administration of the law. Proposed municipal conservation plans set per capita use rates for cities, towns and private water companies. The agricultural conservation program actually sets a limit as to how much water a given farmer may pump to irrigate his land and how much land is governed by the irrigation grandfathered rights. Industrial conservation technologies focus primarily on five water intensive industries: electric power generation, mining, turf irrigation, sand and gravel, and dairies. The current status of Indian water rights in Arizona is summarized. (Baker-IVI)
W85-04756

PROPOSED LEGAL FRAMEWORK FOR THE REGULATION OF DRINKING WATER,
Canadian Environmental Law Association, Toronto (Ontario).
D. G. Edward.
Water and Pollution Control, Vol. 122, No. 3, p 21-22, 24, 27-28, May/June, 1984. 2 Ref.

Descriptors: *Water quality control, *Regulations, *Canada, *Drinking water, Enforcement, Monitoring, Water treatment, Water supply, Legislation.

The existing threat to the supply of drinking water for Canada is reviewed and problems are highlighted in the current system of regulations which are supposed to safeguard this supply. A Safe Drinking Water Act Proposal is discussed which is not intended to deflect attention from pollution abatement and control. Due to the ongoing problem of cleaning up existing sites and enforcement of prohibitions against further injection of contaminants into the air and water, it is necessary to control the quality of drinking water at the point of consumption. The main responsibility for the enforcement of the proposed Safe Drinking Water Act would lie within the provinces. Public water suppliers would be required to periodically sample and test drinking water. Members of public would be given standing to bring civil actions against anyone for damages arising from a breach of regulations. The Act would require public water suppliers to notify customers and the general public when the system was not performing properly or adequately and to provide alternative sources of supply when necessary. Mandatory research into certain critical water quality problems would be provided for. (Baker-IVI)
W85-04766

6F. Nonstructural Alternatives

FLOODPLAIN POLICY AND PRACTICE IN THE CREDIT RIVER WATERSHED, ONTARIO,
Grand River Conservation Authority, Cambridge (Ontario).
B. J. Veale, and B. Mitchell.
Canadian Water Resources Journal, Vol. 8, No. 3, p 39-57, 1983. 3 Fig, 2 Tab, 27 Ref.

Descriptors: *Floodplain management, *Public policy, *Credit River watershed, *Ontario, Nonstructrual alternatives, Flood control, Public opinion, Economic aspects, Jurisdiction, Urban areas, Institutional constraints.

Analysis of floodplain policy and practice in the Credit River watershed in Ontario revealed that although there has been an increase in the use of non-structural adjustments, municipalities and residents favor structural adjustments to reduce flood hazard at the community level. Several factors contribute to discourage wide spread acceptance and adoption of non-structural adjustments. First, available financial arrangements provide an incentive for water managers to select structural solutions rather than non-structural adjustments. Second, enforcement of non-structural floodplain management alternatives is difficult. Third, communication problems among residents and resource agencies often undermine adjustments, such as flood warning systems. Fourth, jurisdictional fragmentation among resource agencies results in overlapping responsibilities and duplication of management activities which mitigate against a systematic and integrated approach to reducing urban flood problems and allows agencies to evade their responsibilities. These findings support results from an earlier study of floodplain policy and practice in the Grand River watershed in Ontario, and suggest that similar trends may predominate in other Ontario watersheds. (Author's abstract)
W85-04587

CANADIAN WATER MANAGEMENT: A ONE ARMED GIANT,
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 6A.
W85-04685

ROLE OF PRICING IN MANAGING THE DEMAND FOR WATER,
Wilfrid Laurier Univ., Waterloo (Ontario).
For primary bibliographic entry see Field 6A.
W85-04686

6G. Ecologic Impact Of Water Development

RESERVOIR SEDIMENTATION IN INDIA -- ITS CAUSES, CONTROL, AND FUTURE COURSE OF ACTION,
Land Use Consultants (International), New Delhi (India).
K. G. Tejwani.
Water International, Vol. 9, No. 4, p 150-154, December, 1984. 15 Ref.

Descriptors: *Sedimentation, *Erosion, *Reservoirs, *Policy aspects, *Management planning, Land use, Agricultural watersheds, Watersheds.

Sedimentation studies of 21 major reservoirs in India have shown that the annual rate of siltation from a unit catchment has been 40 to 2166% more

than was assumed at the time of project design, for an average of about 200% more than the design inflow. The high rates of sedimentation in India are due to the gross misuse of, and mismanagement of, land by man and his animals. Due to the high agricultural land use, usually the land which is unsuited for agriculture is also cultivated and the population density on the cultivated land is very high. At present, India has a good research infrastructure focusing on conservation of soil and water, reducing erosion and rates of sedimentation. Soil erosion and sediment generation can be reduced by biological and mechanical measures. At present, a reservoir is treated as a discrete, independent unit without fully appreciating the fact that it is only one part of a land-water management system which includes the catchment area and command area of the reservoir. It is general practice that a reservoir is conceived, surveyed, planned, designed, constructed and operated without ever giving serious thought to the management of the catchment and the command areas. Policy and planning aspects which need greater attention at present include (1) developing the catchment area, reservoir and command area as a package and (2) recognizing and treating sediment as the greatest pollutant in the developing world. A policy for effective water resource and hydropower development, watershed and command area development must take into account the short term, direct and indirect, private and social benefits, and endeavor to involve the people and the employees in such a way that they feel committed to efficient and effective implementation. (Collier-IVI)
W85-04439

EVALUATION OF ECOLOGICAL FORECASTING PREVIOUS TO THE HYDROELECTRIC DEVELOPMENT OF A NATURAL SUBARCTIC RESERVOIR (ÉVALUATION ET PRÉVISION ECOLOGIQUE PREALABLE A L'AMENAGEMENT HYDROELECTRIQUE D'UN RESERVOIR NATUREL HEMIARCTIQUE),
Eco-Research Ltd., Pointe Claire (Quebec).
R. Van Coillie, A. Dumouchel, G. Hayeur, and P. Lamothe.
Canadian Water Resources Journal, Vol. 8, No. 1, p 60-82, 1983. 4 Fig, 7 Tab, 15 Ref.

Descriptors: *Water resources development, *Ecological effects, *Hydroelectric plants, *Subarctic zone, *Reservoirs, *Grande Riviere de la Baleine, *Quebec, *Lake Bienville, Wildlife habitats, Planning, Project planning.

The hydroelectric development of La Grande Riviere de la Baleine basin in Hudson Bay Area of Quebec, presupposes that Lake Bienville, a natural reservoir (1474 sq km) in its head waters, will be transformed into a regulated reservoir with a maximum drawdown of 8.25 m and a 530 km sq increase in its total area. In order to determine the ecological impact of this modification, the methodological approach was based on pre-available data, in situ observations and anticipated physical changes taking into account certain limiting factors in such a study (climatic conditions and the size of the study area). A survey of shorelines, vegetation and aquatic conditions was effected with respect to the anticipated changes. Simultaneously, an attempt was made to determine the utilization of these areas by wildlife resources (caribous, fish, wildfowl). The 5-yr (1975-1980) study showed that the loss of 2/3 of shoreline boga, 6% spruce stands, 300 islands usually having tundra characteristics, 202 peripheral lakes, the discharge of the lake and its ecotones will have limited repercussions on these resources; the repercussions could be mitigated. (Author's abstract)
W85-04575

SEDIMENT BUDGET STUDY OF CLAMSHELL DREDGING AND OCEAN DISPOSAL ACTIVITIES IN THE NEW YORK BIGHT,
Corps of Engineers, New York. New York District.
J. F. Tavolaro.
Environmental Geology and Water Sciences, Vol. 6, No. 3, p 133-140, 1984. 3 Fig, 4 Tab, 19 Ref.

Descriptors: *Dredging, *Ocean dumping, *Sediment budget, *New York Bight, Turbidity, Environmental effects, Plumes, Waste disposal.

The purpose of this study was to quantify the dry mass of dredged material involved in each stage of typical clamshell dredging and ocean disposal activities in order to identify and quantify 'losses' of dredged material. Turbidity plumes generated at dredging sites were also observed. Approximately 2% of the dredged material was lost at the dredging site. Of this quantity 61% was due to the dredging itself and 38% was due to intentional barge overflow. Approximately 3.7% of the dredged material was lost at the Mud Dump Site during disposal. Total loss of dredged material during these clamshell dredging and ocean disposal operations was calculated to be 5.6%. Observations revealed that turbidity plumes were local features which traveled along the bottom for several hundred feet. These plumes only persisted while dredging was occurring, and ambient conditions were established within a relatively short time after dredging ceased. (Author's abstract)
W85-04598

NATURAL FACTORS AND HUMAN MODIFICATIONS CONTRIBUTING TO MARSH LOSS IN LOUISIANA'S MISSISSIPPI RIVER DELTAIC PLAIN,
Louisiana State Univ., Baton Rouge. Dept. of Marine Science.
For primary bibliographic entry see Field 2L.
W85-04603

FACTORS INFLUENCING IMPINGEMENT OF FISH BY LAKE ONTARIO POWER PLANTS,
Hartwick Coll., Oneonta, NY. Dept. of Biology.
For primary bibliographic entry see Field 8I.
W85-04713

SIMULATED EFFECTS OF FERTILIZER MANAGEMENT ON NITRATE LOSS WITH TILE DRAINAGE WATER FOR CONTINUOUS CORN,
Iowa State Univ., Ames. Dept. of Agricultural Engineering.
R. S. Kanwar, J. L. Baker, and H. P Johnson.
Transactions of the American Society of Agricultural Engineers, p 1396-1399 and 1404, 1984. 3 Fig, 2 Tab, 13 Ref.

Descriptors: *Computer simulation, *Fertilization, *Tile drainage, *Continuous cropping, *Drainage, Agricultural runoff, Nitrogen, Fertilizer management.

A computer simulation model was used to estimate the impact of different fertilizer management practices for continuous corn production on the loss of nitrate-nitrogen with tile drainage water. Simulations using historical weather data were conducted for seven consecutive growing seasons for a location in Iowa. Currently, nitrogen management by most farmers in Iowa can be represented by a single application (usually NH3-N) of about 150 kg/ha. Management schemes tested to improve the efficiency of nitrogen use include fertilizer application rates, and timing and the number of applications. Model results indicate that lower application rates and multiple applications significantly decrease nitrate-nitrogen losses in both wet and dry years. (Author's abstract)
W85-04739

ENVIRONMENTAL CONTROL AND REGIONAL GROWTH,
Clemson Univ., SC. Dept. of Economics.
B. Yandle.
Growth and Change, Vol. 15, No. 3, p 39-42, July, 1984. 1 Fig, 2 Tab.

Descriptors: *Economic aspects, *Environmental control, *Regional development, Community development, Industrial wastes, Water pollution control, Regulations.

Research is reported which focuses on the relationship between economic development across states, as measured by growth in value added in manufacturing, and actions taken to control pollution. A simple theory of that relationship is presented first. Then, based on a proposition from the theory, an empirical model is posited and results of statistical tests are reported. The evidence presented supports the hypothesis that restrictions on pollution and the associated investment in pollution control capital in the 1970s had a significant effect on regional growth patterns. In three different models, the amount of nonurban space present in a region was significantly and positively associated with growth in value added. The percentage of the labor force employed in industries that faced heavy investments in pollution control capital at the beginning of the period examined showed a significant and negative effect on growth in three models. In many cases heavily polluting industries, required to invest heavily in environmental controls, were concentrated regionally, as accounted for by employment statistics, and the states where they were located in many cases suffered relative to other states. (Baker-IVI)
W85-04755

ENVIRONMENTAL MANAGEMENT PLANNING FOR DAMS AND HYDRO SCHEMES.
International Water Power and Dam Construction, Vol. 37, No. 1, p 41-44, January, 1985. 2 Fig, 2 Tab.

Descriptors: *Environmental effects, *Water resources development, *Dam effects, *Hydroelectric plants, Planning, Water management, Hydroelectric power, Tidal power, Developing countries, Regional development.

Discussions on how to minimize the negative impact on the environment of dams, hydro plants and tidal power schemes formed part of a recent conference on environmental management planning in the mining and energy industries. Several small hydro schemes seem preferable to one large project, where conditions are appropriate, and care should be taken to evalute the impact of large dams in tropical regions. Problems encountered in the Nimas basin tidal power scheme are that time scales for engineering designs and environmental studies differed considerably, many of the locations being studied were rather remote and there was therefore a lack of adequate data and there were separate Federal and Provincial jurisdictions which could confict. A stepped matrix technique was explained for identifying the impact of hydro projects. The technique aimed to formalize the integration of the Environmental Impact Assessment (EIA) and to solve some of the problems which could arise between developers and conservationists. An English case study was presented concerning the EIA on a proposed pumped-storage project at Tintwistle near Manchester. Physical changes which would be brought about through the development of tidal power at the Fundy Bay were described. The use of collective benefits over and above mitigation measures to communities to be affected by a water resources development project was described as it relates to mitigation measures at James Bay. Problems of hydro schemes in developing countries were also considered. (Baker-IVI)
W85-04784

NUTRIENT BUDGETS FOR AGRICULTURAL WATERSHEDS IN THE SOUTHEASTERN COASTAL PLAIN,
Agricultural Research Service, Tifton, GA. Southeast Watershed Research Center.
R. R. Lowrance, R. A. Leonard, L. E. Asmussen, and R. L. Todd.
Ecology, Vol. 66, No. 1, p 287-296, February, 1985. 3 Fig, 6 Tab, 28 Ref. NSF grants DEB 78-10841 and DEB 82-07210.

Descriptors: *Agricultural watersheds, *Nutrients, *Georgia, Precipitation, Streamflow, Fertilizers, Land use, Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Chlorides, Water pollution sources.

Watershed-level agroecosystem studies are essential to relate land management to the external environmental effects produced by agricultural nutrients and to enhance our understanding of agricultural nutrient cycles. Inputs and outputs of N, P, K, Ca, Mg, and Cl were determined for four subwatersheds of the Little River in the Georgia Coastal Plain from 1979 through 1981. The four watersheds had 40, 36, 54, and 50%, respectively, of their land in agricultural uses (row crop and pasture). Precipitation inputs and streamflow outputs were determined by field sampling of water volumes and nutrient concentrations. Agronomic inputs (from fertilizer and symbiotic N-fixation) and outputs in harvested material were estimated from land use data; countywide averages of fertilizer applications and crop yield; and plot studies on peanuts and soybeans. All elements except Cl had greater inputs than outputs on each watershed each year. The general order of streamflow loads was Cl > Ca > K > Mg > N > P. Fertilizer inputs exceeded precipitation inputs for all elements on all watersheds. Outputs of N, P, and K in harvest generally exceeded streamflow loads, but harvest outputs of Ca, Mg, and Cl were generally lower than streamflow loads. The two watersheds with more agricultural land had consistently higher loads on N, K, Ca, Mg, and Cl in streamflow and had NO3-N loads 1.5 to 4.4 times higher than loads from the less agricultural watersheds. Streamflow loads on the Little River watersheds were similar to those on other Coastal Plain agricultural watersheds with comparable land use and discharge volumes. Budgets for the upland portion of one of the watersheds indicated that large amounts of N, P, K, Ca, and Mg were not accounted for. About 56 kg/ha/yr of N were retained or lost to gaseous emissions from the uplands. Apparently, a large percentage of the nutrients applied to these watersheds was being retained somewhere in the watershed or being lost in some unquantified way. (Author's abstract)
W85-04826

HUMAN MODIFICATION OF MOLLUSCAN HABITATS IN LITTLE CREEK ESTUARY, VIRGINIA,
Northeastern Univ., Boston, MA. Dept. of Earth Sciences.
R. H. Bailey.
Nautilus, Vol. 99, No. 1, p 1-6, January, 1985. 5 Fig, 8 Ref.

Descriptors: *Little Creek Estuary, *Virginia, *Mollusks, *Habitats, Estuarine environment, Population dynamics, Dredging, Environmental effects.

Mollusks of Little Creek estuary in southeastern Virginia may be grouped into five assemblages indicative of the following benthic habitats: fringe and embayed Spartina marsh, solid substrata, intertidal muddy sand, subtidal muddy sand, and black organic mud. Human activities have signifiantly altered the distribution of mollusks in the creek by modifying basin configuration, hydrograph, and substratum distribution. No molluscan habitat appears to have been entirely eliminated, though all have changed. The substratum distribution map successfully delimits the habitats potentially available to molluscan assemblages even though an expected assemblage may not fully occupy areas of preferred substratum at the instant of sampling. Changes in bottom type associated with human activities in and around the estuary can be monitored easily and quickly, and the ultimate effect on molluscan species or assemblages can be predicted. (Baker-IVI)
W85-04859

BIOLOGY OF BRACHYCENTRUS SUBNUBILUS CURTIS (TRICHOPTERA) IN THE RIVER FROME, DORSET,
Freshwater Biological Association, Wareham (England). River Lab.
For primary bibliographic entry see Field 2H.
W85-04887

7. RESOURCES DATA

7B. Data Acquisition

ESTIMATION OF SULPHATE IONS IN WATER AND INDUSTRIAL WASTES USING A SOLID STATE MEMBRANE ELECTRODE,
Roorkee Univ. (India). Dept. of Chemistry.
S. K. Srivastava, and C. K. Jain.
Water Research, Vol. 19, No. 1, p 53-56, 1985. 4 Fig, 4 Tab, 11 Ref.

Descriptors: *Sulfates, *Electrodes, *Chemical analysis, *Water analysis, Industrial wastewater, Instrumentation.

Previous attempts to construct electrodes selective to sulfate ions have been susceptible to interference by S(-2), SO3(-2), etc., anions and a number of cations. A solid membrane electrode selective to sulfate ions, has been prepared from hydrous thorium oxide gel with polystyrene as binder. Membranes were prepared by mixing 0.225 g polystyrene and 1.275 g THO and heating the homogenous mass in a die of diameter 1.5 cm kept in a metallurgical specimen mount press at 120 C under a pressure of 6500-7000 psi; stable membranes of 1.5 mm were obtained. Although the electrode is non-Nernstian in nature it can be utilized to estimate sulfate ions in the concentration range 0.1 - 0.0001 M. The useful pH range for this assembly is 6 - 10. It can also be used in partially non-aqueous systems. The membrane electrode shows good selectivity to SO4(-2) ions and there is practically no interference of a large number of anions and cations. The electrode can be used for 4 months without showing any drift in slope, while the linear range and slope decreased slowly after continuous use over a long period. If the electrode shows deterioration, regeneration may be attempted by equilibrating it again with 0.1 M potassium sulfate. It has been used to estimate SO4(-2) ions in wastes from Paper and Pulp and Tannery industries. (Collier-IVI)
W85-04488

MEASUREMENT OF THE PERFORMANCE OF SEWERAGE SYSTEMS AND ASSOCIATED HYDRAULIC STRUCTURES - RECENT DEVELOPMENTS,
For primary bibliographic entry see Field 5D.
W85-04511

DIFFERENT APPROACH TO WATER QUALITY SAMPLING,
Wessex Water Authority, Poole (England).
For primary bibliographic entry see Field 5A.
W85-04524

SMALL FORMAT, HAND HELD HELICOPTER BASED PHOTOGRAPHY FOR MONITORING INDUSTRIAL WATER EFFLUENT PLUMES,
Waterloo Univ. (Ontario). Dept. of Geography.
E. F. LeDrew, and S. E. Franklin.
Canadian Water Resources Journal, Vol. 8, No. 3, p 26-38, 1983. 3 Fig, 1 Tab, 9 Ref.

Descriptors: *Path of pollutants, *Aerial photography, *Plumes, *Ontario, *Lake Erie, Industrial wastewater, Remote sensing, Dispersion, Effluents, Dye releases, Helicopters.

In the planning and design of water pollution treatment facilities and in the management of water quality, a significant parameter is the dispersion characteristics of the effluent plumes. The geometry and dimensions of the water effluent plume from a steel making facility at Nanticoke, Ontario, on the north shore of Lake Erie were mapped for six cases with different dispersion characteristics. Small format aerial photography with a dye tracer was used to provide cost effective and accurate information on the dispersion configurations. Interpretation of the remote imagery was verified using water quality data collected during ground information missions co-ordinated with three of the aerial photography flights. From the aerial photography, the effluent boundary is clearly evident. An estimate of the mixing zone of about 120 hectares was based upon a fluid dispersion model. In the six cases mapped, the plume, as determined by chroma contrast, was not greater than 3.2 ha and on one occasion shrank to 0.1 ha. This is significantly less than the model prediction. Only for the case of southeast air flow was the major dispersion component offshore. In the other cases, which represent northwest, southwest, south and northeast air flow, the major dispersion axis was parallel to the shore and typically constrained within 200 m of shore. (Moore-IVI)
W85-04586

TREES SCARS TO DETERMINE THE FREQUENCY AND STAGE OF HIGH MAGNITUDE RIVER ICE DRIVES AND JAMS, RED DEER, ALBERTA,
Calgary Univ. (Alberta). Dept. of Geography.
D. G. Smith, and D. M. Reynolds.
Canadian Water Resources Journal, Vol. 8, No. 3, p 77-94, 1983. 6 Fig, 3 Tab, 20 Ref.

Descriptors: *Tree scars, *Ice jams, *Ice drives, *Red Deer River, *Alberta, Floods, Flood frequency, Flood stage, Trees.

An indirect method of using tree scars to determine stage and frequency of ice drives and jams was tested on the Red Deer River at Red Deer, Alberta. The method involves determining the ages and heights of ice scars on river bank tree trunks. Cores, wedges, and slice cross-sections of scarred trunks were sampled to determine scar ages. Heights of the scars above the river surface were also measured. Often scars on a single tree were overlapped and/or located at different heights on the trunk, thus recording multiple ice drive events. The height and age record of ice scarred trees were then compared against the hydrometric and historical record of ice drives and jams. The comparison suggests that by applying a correction factor the indirect method of using tree scars to assess frequency and stage of ice drives and jams is reliable, and shows considerable promise. The method is particularly applicable to rivers which are ungauged or are without a long term hydrometric record. (Author's abstract)
W85-04589

SAMPLING TUBING EFFECTS ON GROUNDWATER SAMPLES,
Illinois State Water Survey Div., Champaign. Aquatic Chemistry Section.
M. J. Barcelona, J. A. Helfrich, and E. E. Garske.
Analytical Chemistry, Vol. 57, p 460-464, February, 1985. 3 Fig, 4 Tab, 18 Ref.

Descriptors: *Sampling, *Tubes, *Errors, *Organic compounds, *Groundwater sampling, Teflon, Polyethylene, Polypropylene, Polyvinyl chloride, Silicone rubber, Volatile compounds, Sorption.

Five common flexible tubing materials were investigated under simulated sampling conditions for the recovery of volatile halocarbons (chloroform, trichloroethylene, trichloroethane, and tetrachloroethylene) frequently identified in contaminated groundwater samples. Tubes evaluated were made of Teflon, polyethylene, polypropylene, polyvinyl chloride, and silicone rubber. Each of these was found to sorb the test compounds in short exposure periods. Virgin tubing materials introduce substantial amounts of leachable organic matter in similar exposures. The Teflon tubing showed the least absorption and leaching problems and should be the tubing material of choice for detailed organic sampling purposes. Absorption into the polymer matrix is the likely mechanism for the errors. A comprehensive evaluation of sampling mechanisms, sample transport tubing, and storage precautions should be made a part of the planning of all groundwater sampling protocols. (Baker-IVI)
W85-04655

METHOD TO MEASURE SUSPENDED LOAD TRANSPORTS IN ESTUARIES,
Institut fuer Meeresforschung, Bremerhaven (Ger-

many, F.R.).
For primary bibliographic entry see Field 2L.
W85-04675

NEAR BOTTOM VARIATIONS OF TURBIDITY IN THE ST. LAWRENCE ESTUARY,
McGill Univ., Montreal (Quebec). Inst. of Oceanography.
For primary bibliographic entry see Field 2L.
W85-04677

HYDRAULIC CONDUCTIVITY MEASURED ELECTRONICALLY IN AN AUGER HOLE,
Louisiana State Univ., Baton Rouge. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W85-04740

MEASUREMENTS AND ESTIMATION IN HYDROLOGY - IDEAS AND PROPOSALS FOR THE QUANTIFICATION OF ERRORS AND UNCERTAINTIES (MESSUNGEN UND SCHATZUNGEN IN DER HYDROLOGIE - GEDANKEN UND VORSCHLAGE ZUR QUANTIFIZIERUNG DER FEHLER UND UNSICHERHEITEN),
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
W. Schilling.
Deutsche Gewasserkundliche Mitteilungen, Vol. 28, No. 3, p 75-78, July, 1984. 4 Fig, 3 Tab, 17 Ref.

Descriptors: *Estimation, *Hydrology, *Error analysis, *Uncertainty, Data interpretation, Statistical studies, Management.

In an applied science such as water resources management, both the measurements and model simulations are subject to errors. This holds true for quantitative estimations, which are characteristic of applied science and engineering, due to the ever-present lack of time and money. Two approaches are proposed for statistically quantifying measurement errors and uncertainties in quantitative estimations. A case study of discharge measurements and estimations at low water presents a possible approach to a quantitative characterization of uncertainties in measurements and estimations. The case study shows that even carefully executed measurements yield scattered results. Measurement data gain content and evidential value if their reliability is known or may be safely assessed. In cases where measurements and application of data are in different hands, information about data reliability should be transferred to the user. The methodological approach presented might be used to solve this problem, which is common to all water resources management disciplines. (Moore-IVI)
W85-04805

1981 CCOPE PROBE MESONET CALIBRATION AND MAINTENANCE MEASURES,
Montana Dept. of Natural Resources and Conservation, Helena.
L. Holman, and J. NcInerney.
Available from the National Technical Information Service, Springfield, VA 22161. Bureau of Reclamation Technical Report, June 1983. 67 p, 21 Fig, 7 Tab. Contract/Grant No. 1-07-81-V0175.

Descriptors: *Calibrations, *Maintenance, *Monitoring, *Precipitation, *Electronic equipment, *Quality control, Rain gauges, Wind velocity, Air temperature, Relative humidity, Barometric efficiency, Temperature, Meteorological data collection, Remote sensing, Montana, Telemetry.

A preseason and postseason calibration testing of the PROBE (Portable Remote Observation of the Environment) mesonet monitoring equipment has been conducted to assure data quality for the 1981 Cooperative Convective Precipitation Experiment (CCOPE). Testing of equipment used to measure wind speed, wind direction, temperature, pressure tendency, relative humidity, and precipitation began in August 1979 and continued through June 1982. Many of the calibration procedures and techniques had not been thoroughly tested for operations in Montana due to the prototype nature of the PROBE stations. Calibration and maintenance measures showed reasonable consideration for the many constraints encountered. As a result, the data quality for each parameter was generally good and the overall station performances were considered acceptable.
W85-04928

INFLUENCE OF SAMPLING FREQUENCY ON THE ESTIMATES OF RUNOFF WATER QUALITY,
National Board of Waters, Helsinki (Finland). Water Research Inst.
T. Kohonen.
Available from Govt. Printing Center, P.O. Box 516, SF-00101 Helsinki 10, Finland. Publication of the Water Research Inst. No. 27, 1982. 30 p, 9 Fig, 14 Tab, 59 Ref.

Descriptors: *Data collections, *Statistics, *Data acquisition, *Theoretical analysis, *Water quality, *Nonpoint pollution sources, *Sampling frequency, *Water sampling, Hydrologic data collections, On-site data collections, Mathematical studies, Water analysis, Sampling, Nitrogen, Phosphorus, Suspended solids, Runoff.

The effect of sampling frequency on estimates of quality and loading were studied during 1968 and 1974 in a cultivated and forested basin for the parameters of total N, total P and suspended solids. The deviations of mean values calculated from samples of different sizes from the means obtained using all the available water quality data were investigated by varying the sampling frequency. In the cultivated basin the means of concentration data would be within +/- 20% of the mean of the whole data set in spring, if N and P samples were taken at least five times and suspended solids samples at least three times monthly. In the forested basin the corresponding sampling frequencies were two times monthly for N samples, and four times monthly for P and suspended solids samples. In autumn, the concentration means in runoff water would be within +/- 20% of the mean obtained using the whole data set if three samples per month were taken for N and P and five samples for suspended solids. In the forested basin the same deviation of the mean would be obtained with one N sample, five P samples and sixteen solids samples per month. The other method used to specify the necessary sampling frequency was based on obtaining the mean of the data within a given relative confidence interval about the true mean at a given confidence level. However, the reliability of the results obtained with this method was poor for these data sets. It was concluded that the sampling frequencies chosen only on the grounds of personnel and laboratory resources may reduce the reliability of the conclusions and actions.
W85-04930

AIRBORNE MICROWAVE MEASUREMENTS OF THE SOUTHERN GREENLAND ICE SHEET,
Massachusetts Univ., Amherst.
For primary bibliographic entry see Field 2C.
W85-04962

7C. Evaluation, Processing and Publication

BASIC PROGRAM FOR THE INVESTIGATION OF SPECIES DIVERSITY,
Heriot-Watt Univ., Edinburgh (Scotland). Dept. of Brewing and Biological Sciences.
C. G. Moore.
Water Pollution Control, Vol. 82, No. 1, p 102-106, 1983. 12 Ref, 1 Append.

Descriptors: *Species diversity, *Computers, *Data processing, Data storage and retrieval, Monitoring.

A program is presented which was written for investigation of the behavior of diversity indices and for the routine processing of monitoring and survey data. The program is interactive and accepts data in a variety of formats including matrices containing zero values. The program is designed to be run from a mainframe terminal. All data can be read from the terminal or species counts and names can be read from a disk file. Data on file can be in the form of a regular matix of counts of individuals of each species in each sample, where the rows are samples and the columns, species. When the program is run, an interactive section follows in which a number of options are chosen and the number of species, samples and individual levels are stated. Thus it is possible to avoid certain routines which are relatively expensive in terms of processor time or paper. (Baker-IVI)
W85-04513

DOING A JOB ON DATA,
Beavercreek Wastewater Treatment Facility, OH.
R. L. Hentrich, Jr., R. Baird, and R. R. Himebaugh.
Water Engineering and Management, Vol. 132, No. 1, p 26-28, January, 1985. 3 Fig, 2 Tab.

Descriptors: *Information systems, *Computers, *Data processing, Data management, Monitoring, Wastewater treatment facilities.

Data management is described for a wastewater treatment facility which monitors a large volume of data on a daily basis. A total of 121 parameters are routinely monitored consisting of meter readings operator measurements, analytical determinations and a number of calculated entries. The total time required each month to calculate daily process control parameters, to perform end of the month column totaling/averaging, and to prepare national Pollutant Discharge Elimination System (NPDES) reports was about 54 hr, or about 7 days of work, or more than 80 days per year lost to record keeping. Installation of The Data Handling System, which is a diskette template program used with Multiplan (a spreadsheet application by Microsoft Corp.) was implemented. This package produced the automatic calculation of parameters and the running average, total maximum and minimum of all columns. The system also offered the automatic calculation and generation of state and federal NPDES reports as well as transfer of all monthly averages to an annual report/log. Reports containing only selected information could also be generated. (Baker-IVI)
W85-04651

INTEGRATED WATER-ENERGY MANAGEMENT SYSTEM FOR CENTER PIVOT IRRIGATION: FUNCTIONAL REQUIREMENTS,
Agricultural Research Service, Fort Collins, CO.
G. W. Buchleiter, D. F. Heermann, and H. R. Duke.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1419-1423, September-October, 1984. 4 Fig, 8 Ref.

Descriptors: *Irrigation operation, *Energy management, *Center pivot irrigation, *Computers, Pumping, Water management, Peak load, Irrigation scheduling, Data processing.

Expanded use of center pivot sprinkler irrigation system in the Great Plains has led to significant increases in irrigated acreage, and dramatic increases in peak load for electricity for pumping. Some power suppliers have implemented load control procedures which reduce the peak demand by interruption of large irrigation loads during peak use periods. An integrated water-energy management system is described which utilizes a microcomputer and radio telemetry system for pump monitoring, pump control, irrigation scheduling and electric load control. The system collects, processes and stores pump operation and weather data automatically yet allows the operator real time control of individual pumps. Less time and effort is required to monitor and control the irrigation pumps. The computer software which prioritizes tasks and has the ability to control pumps at predetermined times allows participation in existing load control programs. The ability to fully participate in a load management program can

provide significant economic incentives to the irrigator and help the power supplier reduce the peak demand. (Moore-IVI)
W85-04742

INTEGRATED WATER-ENERGY MANAGEMENT SYSTEM FOR CENTER PIVOT IRRIGATION: IMPLEMENTATION,
Agricultural Research Service, Fort Collins, CO.
D. F. Heermann, G. W. Buchleiter, and H. R. Duke.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1424-1428, September-October, 1984. 5 Fig, 3 Tab, 4 Ref.

Descriptors: *Irrigation operation, *Energy management, *Center pivot irrigation, *Computers, Pumping, Water management, Irrigation scheduling, Data processing.

Increased energy costs to pump dwindling water supplies has reduced the profitability of irrigated agriculture in some areas of the Great Plains in recent years and pointed to the need for better management of water and energy. An integrated water and energy management system is one method of improving management and participating in a load control program to reduce energy costs. An integrated water-energy management system using a microcomputer provided monitoring, pump control, irrigation schedules, and load control for 15 center pivots in a field test. The system operated with minimal failures. Real-time management data enhances the farmers ability to manage both water and energy to obtain maximum yields. The operator used the system extensively. This system has potential adaptability to a large percentage of center pivot irrigation systems. (Moore-IVI)
W85-04743

INFLUENCE OF SAMPLING FREQUENCY ON THE ESTIMATES OF RUNOFF WATER QUALITY,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 7B.
W85-04930

8. ENGINEERING WORKS

8A. Structures

UNLINED HIGH PRESSURE TUNNELS IN AREAS OF COMPLEX TOPOGRAPHY,
Norges Tekniske Hoegskole, Trondheim. Dept. of Geology.
E. Broch.
International Water Power and Dam Construction, Vol. 36, No. 11, p 21-23, November, 1984. 4 Fig, 10 Ref.

Descriptors: *Tunnels, *Topography, High pressure, Design criteria, Mapping, Stress, Leakage.

In regions with complicated topography, care must be exercised when designing unlined high pressure tunnels or shafts. Protruding ridges and noses do not add much to the stresses in the rock masses in a valley side, and should therefore be neglected. Simplified topographic maps with smooth contour lines, drawn inside such protruding features, should be prepared. Based on these maps, revised vertical profiles can be drawn. These revised profiles should be the basis for the design of high pressure tunnels or shafts without steel linings. In an example, leakage from a tunnel with a water head of 310 m may, in part, be caused by an overestimation of the overburden under a protruding ridge in a valley in a tropical environment. Open cracks in the concrete lining indicates that a concrete-lined tunnel should from a design point of view, be treated as a unlined tunnel. (Baker-IVI)
W85-04412

ECONOMIZING THE DIAMETER OF TUNNELS,
Pipe and Canal Services A.G., Zumikon (Switzerland).
W. Stocker.
International Water Power and Dam Construction, Vol. 36, No. 11, p 24-28, November, 1984. 6 Fig, 3 Tab, 5 Ref.

Descriptors: *Economic aspects, *Design criteria, *Tunnels, Friction, Cost analysis, Tunneling, Tunnel linings.

The standard procedures for finding the most economical diameter of tunnels is reviewed. There is a certain range of friction factors where minimal costs will result. The observation of a distinct least cost minimum has obvious consequences in design. Whenever the rock will allow the designer to choose the standard of finish, the type of plant to be built will primarily influence this standard. For a project producing high cost energy such as a storage plant, a higher standard seems to be adequate. Provided the rock is suitable for making such an evaluation, a low standard will always be the most economical for both types of plants. For the lowest limits, which are hardly ever reached for practical reasons, the lowest practical standard will always lead to the most economical solution. Another influence which has become important only during the past 15 years is the difference in finish when using a tunnel boring machine, compared with that obtained by conventional drilling and blasting methods. In a storage scheme project, producing peak demand energy and with good rock conditions, the cost-conscious engineer would tend towards a bored tunnel solution. With the same cost/design standard thinking, a steel-lined tunnel is not economical. In cases where the permeability of the rock is questionable, a solution with a reinforced crack-limiting concrete lining as suggested by modern design techniques should be evaluated against a conventional steel lining. (Baker-IVI)
W85-04413

UNDERWATER PIERCING OF A TUNNEL,
Norwegian Hydrodynamic Labs., Trondheim.
O. Solvik.
International Water Power and Dam Construction, Vol. 36, No. 11, p 33-36, November, 1984. 6 Fig.

Descriptors: *Tunnel construction, *Hydroelectric plants, *Explosions, Norway, Water resources development, Construction, Erosion, Landslides, Reservoirs, Lakes.

Norwegian consultants and contractors have been confronted with the task of blasting a final penetrating passage that will open the way for the water in a reservoir to flow through to the hydropower turbines. Norway has almost certainly led in this area because of its special topographical and geological conditions. The glacial activities have created a number of natural and very deep lakes forming cheap reservoirs. Piercings at depths up to about 100 m have been performed. Problems tend to increase with depth, but unsuccessful penetration can occur at any depth. When planning an underwater piercing there should be an estimated reservoir requirement based on the hydrological conditions and the profitability of the natural reservoir. The most important condition is the bottom topography of the lake which determines the size of the natural reservoir. Secondary effects to consider include the danger of slides when the water level is lowered, wave erosion along the lowered new shoreline, erosion at all streams and rivers flowing into the lake, and groundwater erosion in the newly exposed dry shoreline. Methods of penetration can be roughly divided into two categories: penetration against the open tunnel shaft (open system); and penetration against the closed tunnel shaft (closed system). (Baker-IVI)
W85-04415

HIGH-HEAD SPILLWAY WITH SWIRLING OF THE FLOW IN THE OUTLET SECTION,
E. G. Donchenko, P. E. Lysenko, and G. A. Chepaikin.
Hydrotechnical Construction, Vol. 18, No. 3, p 115-119, March, 1984. 4 Fig. Translated from Gidrotekhnicheskoie Stroitel'stvo, No. 3, p 17-20, March, 1984.

Descriptors: *Spillways, *Hydroelectric plants, *Construction methods, Energy dissipation, Eddies, High-head dams.

A spillway with a regulating device called an eddy gate, which swirls the flow in the outlet section of the spillway, was proposed as an alternative to the ordinary tunnel spillway of the high-head river hydropower work to reduce the construction time, cost, and work involved. Energy dissipation is accomplished inside the proposed spillway and thus, energy dissipators of the flow at the spillway exit are not required. Ordinary, simple vertical-lift and radial gates can be used in the proposed spillway to regulate and discharge the flow. The hydraulic model investigation performed indicates that at all openings of the main gate of the spillway, the gate operated in the same manner as in ordinary tunnel spillways. Swirling of the flow in the outlet section behind the gate did not affect the operation of the gate. The proposed spillway does not require a long shutdown for converting from a diversion regime to a service regime because the gates can be installed during the construction. (Shieh-IVI)
W85-04420

OPTIMIZATION OF DESIGN PARAMETERS OF COMPLEX SURGE TANKS,
N. N. Arshenevskii, V. V. Berloin, and O. A. Murav'ev.
Hydrotechnical Construction, Vol. 18, No. 4, p 145-148, April, 1984. 5 Fig, 1 Tab. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 12-14, April, 1984.

Descriptors: *Surge tanks, *Optimization, Design criteria, Hydroelectric plants, Costs, Pressure conduits, Diversion structures, Surge pipes, Water level.

Surge tanks are complicated and costly structures. The problem of optimizing the design of a surge tank is solved in the scope of the more general problem of optimizing the design of the pressure conduits of hydrostations and structures on them. The optimization problem consists of finding, for a given system of pressure conduits and design regimes, a combination of design parameters for the surge tank such that it determines its minimum cost. The initial data of the optimization problem are: the geometric characteristics of the conduits; the design regimes of buildup and drop of the load, the elevations of the upper pool level corresponding to them and the roughness coefficients of the conduit lining; the maximum allowable piezometric head in the diversion and minimum allowable decline of the level in the tank; range of variation of the design parameters being optimized; unit cost of structural elements of the tank. The basic principle of the proposed method is a hierarchical approach to the selection of the optimal combinations of the investigated parameters, the number of which determines the number of levels of calculation. A differential surge tank is considered in which the optimization is concerned with the diameter of the surge pipe, elevation of the overflow of the surge pipe, area of the chamber around the surge pipe, and area of the orifices. The method makes it possible to compare variants of surge tanks of various types with respect to their cost. The diversion is not taken into account, since a unified maximum pressure is assigned as the initial conditions of calculation in it. (Baker-IVI)
W85-04426

EXPERIENCE IN OPERATING THE BRATSK RESERVOIR,
For primary bibliographic entry see Field 4A.
W85-04429

JAMUNA RIVER 230 KV CROSSING - BANGLADESH, I. DESIGN OF FOUNDATIONS,
Rendel, Palmer and Tritton, London (England).
L. W. Hinch, D. M. McDowell, and P. W. Rowe.
Proceedings of the Institution of Civil Engineers, Part 1, Vol. 76, p 927-949, November, 1984. 14 Fig, 3 Tab, 10 Ref, 1 Append.

Descriptors: *River beds, *Bangladesh, *Jamuna River, *Caissons, *Transmission lines, *Foundations, *Design criteria, Streambeds, Earthquakes, Engineering.

A powerline crossing of the Jamuna River (Bangladesh) has been the subject of studies and investigations for some 20 years but the project has hitherto lacked the economic viability needed to proceed. The Jamuna River Crossing is part of the 230 kV East-West Interconnection project which interconnects the East and West networks of the Bangladesh Power Development Board. In 1979 consultants were appointed to update, revise, and develop earlier design information and to carry the project through its conclusion. The best location for the crossing had previously been defined to be at Aricha, 6 km above the confluence of the Ganges and Jamuna Rivers. This location was considered to be less likely to be bypassed by the changing river course than any other location along the river. At this point the river is 12 km wide in the rainy season and gives rise to possibly the longest river crossing of its kind in the world. When the initial design studies were made before 1968, the Ganges was about 10 km from the line of the proposed crossing; by 1979, the Ganges had migrated to within 2 km of the line. Design of the caissons had to allow for all possible future riverbed movements as well as for local scour due to the caissons themselves. The caissons were checked using a computer to check ultimate load design and additional loading conditions were introduced to allow for earthquake effects and ship impacts. Caissons were not designed for the worst combination of all possible forces; with respect to ship impact, a force of 500 t was taken at the top of the caisson which produced a moment at the point of maximum bending which was appreciably less than the moment from wind loads on the tower and only about half of the moment due to earthquake. (Collier-IVI)
W85-04470

MASINGA DAM IN KENYA,
Watermeyer, Legge, Piesold and Uhlmann, Braamfontein (South Africa).
D. D. A. Piesold, J. Tattersfield, and C. W. Hodgson.
Proceedings of the Institution of Civil Engineers, Part 1, Vol. 76, p 999-1025, November, 1984. 15 Fig, 2 Tab, 1 Append.

Descriptors: *Masinga Dam, *Kenya, *Tana River, *Design criteria, *Dams, *Hydroelectric plants, Powerplants, Streamflow, Reservoir capacity, Runoff, Suspended load, Design flow.

Masinga Dam, officially opened in December, 1981 on the Tana River, is one of Kenya's largest development projects. Sited at the head of the Seven Forks reach, the 1560 M cu m of storage provided by the reservoir will increase power output at the vital hydroelectric power stations downstream and secure flows for irrigated agriculture in the lower reaches. The principal elements of the scheme are a 55 m high, 2.4 km long earth/rock dam (4.9 M cu m fill volume), and overflow chute spillway (capacity 2200 cu m/s) and a 40MW power station. A design flood was estimated from daily historical runoff records for durations of 1-60 days; the 100 year flood was estimated as 1745 cu m/s and the 10,000 year inflow to the reservoir was estimated to be 3100 cu m/s before routing. Assuming an average suspended sediment density of 1.4 t/cu m and allowing for bedload in addition to recorded suspended sediment, the estimated mean annual loss of reservoir capacity is 3.0 M cu m, which is relatively small compared to the reservoir gross capacity. The embankment was constructed from locally-won rock and soils. The river bed height of the dam is 55 m and the crest length of the main wall is 2.4 km. Two saddle dams west of the main embankment have an additional crest length of 1 km. The spillway design flow, with a return period of 1 in 10,000 years, was determined to be 2700 cu m/s after flood routing through the reservoir. The best way to accomodate this was to construct a main spillway of 2200 cu m/s capacity supplemented by an erodible fuse-plug capable of passing the remaining flow. (Collier-IVI)
W85-04471

DEVELOPMENTS IN MATERIALS AND DESIGN TECHNIQUES FOR SEWERAGE SYSTEMS,
Binnie and Partners, London (England).
E. W. Flaxman, and N. J. Dawes.
Water Pollution Control, Vol. 82, No. 2, p 164-178, 1983. 4 Fig, 1 Tab, 35 Ref.

Descriptors: *Design criteria, *Construction, *Sewers, Hydraulics, Reviews, Corrosion, Pipes.

During the last 20 years there has been a considerable increase in understanding the forces and processes that affect the design and durability of sewerage systems. Some of the advances have been the result of original research, but probably more important has been the assembly and presentation of existing technologies in forms which engineers can readily apply to design problems. Gaps in current knowledge include the adoption of the Colebrook-White equation for all sewer flow calculations; a reliable system for assessing the roughness values of gravity sewers, taking account of pipe sliming and silted inverts; further studies to verify appropriate roughness values for sewage pumping mains; field investigations to confirm sediment transport theory for sand in sewage; corrosion-resistant pipes capable of being made in remote locations and of being safely installed without specialist supervision, covering the full range of sizes; a review of the economies of pipe bedding and strengths; and an international compendium of current sewerage research projects. (Baker-IVI)
W85-04517

'RENNFELD' SMALL-SCALE HYDROELECTRIC POWER PLANT NEAR PFORZHEIM (KLEINWASSERKRAFTANLAGE 'RENNFELD' BEI PFORZHEIM),
Weber (Werner) G.m.b.H., Pforzheim (Germany, F.R.).
A. Hutarew.
Wasserwirtschaft, Vol. 74, No. 12, p 577-580, December, 1984. 7 Fig.

Descriptors: *Hydroelectric plants, *Pforzheim, *Germany (Federal Republic), Construction, Small hydropower, Trash racks, Automation, Turbines.

Construction of the Rennfeld hydroelectric power plant at Pforzheim, Federal Republic of Germany demonstrated that small-scale plants (1 MW) can be completed economically within a short time (11 months). Application of suitable rates for energy produced by such low-capacity installations allows them to move to within the profit zone. The new Rennfeld plant is located directly in the bed of the Enz river. Head was thereby increased from 3.8 to 5.7 m; cost-effective construction was realized, and profitability was increased. Rennfeld consists of a three-field weir (each 6.9 m wide) with the turbine house forming the downstream face of the left weir field and an access house containing hydraulic and control equipment on the river bank. In order to fully exploit discharges of 4-20 cu m/sec, two Kaplan pipe turbines with bevel gearing were installed. The turbine intakes were equipped with a horizontal rack installed at 45-degree angle and having a rotating cleaning machine. A cleaner for each turbine field removes material from the horizontal rack to a 1-m wide vertical rack, whose cleaning machine takes it into the access house. Automatic control takes the form of four separate modules (water level, gates, machines, trash rack) coordinated through a control module, which also incorporates optical-observation data and communicates with central control in the city. Water regulation by an upstream weir and favorable conditions during the 1984 discharge year facilitated the short construction time. (Gish-IVI)
W85-04629

DETERMINING EXTRANEOUS FLOWS IN WASTE WATER SYSTEMS,
Waterloo Univ. (Ontario).
B. A. Benninger.
Canadian Water Resources Journal, Vol. 9, No. 3, p 40-43, November, 1984. 1 Fig, 7 Ref.

Descriptors: *Sewer inflow, *Sewer infiltration, *Sewer systems, *Maintenance, Infiltration, Costs, Economic aspects, Linings, Grouting.

Inflow and infiltration may exert stress on the hydraulic capacity of a sewage treatment system. Extraneous flow results in increased sewage treatment cost and an accelerated requirement for sewage treatment plant expansion. Such costs can be avoided or possibly deferred if the extraneous flows are detected and rectified. Should it be suspected that a system may be experiencing an inflow/infiltration problem to the extent that the cost of accommodating the additional water may be greater than the cost of detecting and repairing the sources of the problem, then an inspection and costing of a rejuvenation program for the system should be implemented. Methods for conducting evaluation surveys include smoke testing, sewer damming, semi-permanent transducers, and closed circuit television survey. Once the sources of infiltration and inflow have been located and it has been decided that it is economical to rectify the problem the municipality must examine the available modes of system rejuvenation. Available methods include: excavation and replacement; insertion of plastic liners into existing sewers; and injection of adhesive compound and compaction. In high traffic areas where sewer pipes are structurally intact but porous or loosely jointed, the method of plastic relining may supercede actual removal and replacement. Under certain circumstances of cracked pipes, a sleeve packer and an adhesive grouting mixture may be utilized to mend the leaks; this approach allows the interior of the suspect pipe to be lined with a thin layer of concrete adhesive - however, surrounding groundwater pressure may cause failure of the internal repair. (Collier-IVI)
W85-04689

RELINING: THE FEASIBILITY OF INSERTING PIPE INTO EXISTING SEWERS,
Duratron Systems Ltd., Scarborough (Ontario).
H. St. Onge.
Canadian Water Resources Journal, Vol. 9, No. 3, p 58-65, November, 1984. 6 Fig, 2 Tab, 4 Ref.

Descriptors: *Relining, *Sewers, *Maintenance, Pipelines, Polyethylene pipe.

Insertion renewal systems for collecting wastewater are an economical means of environmental protection. Relining involves the insertion of polyethylene pipe through existing sewers and along the existing line of grade. It facilitates the replacement of failing sewers without disrupting vehicle and pedestrian traffic or interrupting consumers' service. The cost of relining is about one half that of replacing sewer lines. The procedure for relining may include video analysis, removal of obstructions, cleaning of sewers, insertion of shafts, insertion of the polyethylene pipe, anchoring and sealing, and reconnection of laterals. Operating benefits include: a smooth interior for improved hydraulic capacity; the sealed system prevents entry of groundwater, roots, and debris; and minimization of sewer backup and flooded basements. More customers can be added to the system in the long term and reduction of extraneous water allows the treatment plant to operate with improved efficiency. (Collier-IVI)
W85-04693

SOLVING THE PROBLEM OF REHABILITATING DECAYED SEWER SYSTEMS,
Water Research Centre, Marlow (England).
B. Odell.
Water and Pollution Control, Vol. 122, No. 4, p 25, 36-37, July/August, 1984.

Descriptors: *Sewer systems, *Rehabilitation, *England, Linings, Maintenance, Computers, Closed circuit television.

Sewer collapses may be caused by long term leakage of sewage from a cracked sewer, insidiously washing away the surrounding soil. The disruptive cost of these sewer collapses is high and can involve major dislocation of transport and com-

merce. For coping with flooding problems the main objectives have been to avoid the disruption and cost of replacing old sewers. Duplicate sewers or the installation of new linings are possibilities. Preventive maintenance efforts should initially be concentrated on the 20% of the sewage system which is in critical condition, leaving the remainder alone for the present time. In response to the need, a closed circuit television process has been refined to produce high resolution pictures from inside small diameter pipes and a variety of remotely controlled equipment has been developed. This includes precision machines for internal pipe drilling, water jet cutters to remove branch pipe protrusions and equipment for spray on linings. A number of computer models have been devised to analyze flow and assist the planning of remedial measures. (Baker-IVI)
W85-04768

FLOW BALANCING SYSTEM FOR STORM-WATER AND COMBINED SEWER OVERFLOW,
For primary bibliographic entry see Field 5D.
W85-04772

URIBANTE-DORADAS HYDRO DEVELOPMENT IN VENEZUELA,
CEH Ingenieros Consultores, Caracas (Venezuela).
D. F. Fernandez.
International Water Power and Dam Construction, Vol. 37, No. 1, p 35-38, January, 1985. 7 Fig.

Descriptors: *Dam construction, *Uribante-Doradas development, *Venezuela, Water resources development, Geological fractures, Hydroelectric plants, Planning, Water management.

To provide power supply to the western region of Venezuela, the government-owned electrical power company is constructing the Uribante-Caparo hydroelectric project, with a generating capacity of 1276 MW. The project is described with particular emphasis on the first stage, known as the Uribante-Doradas development, where construction is well advanced. The project area contains a system of faults which run parallel to the Andes range. When completed the project will include three reservoirs, four earthfill dams with heights between 115 and 140 m, two power tunnels, three powerhouses and a diversion tunnel. Details are provided on reservoir works and power generation works. (Baker-IVI)
W85-04783

MALAWI - DRIVING A 9 M DIAMETER POWER CONDUIT WITH LOW COVER AT NKULA FALLS,
Watermeyer, Legge, Piesold and Uhlmann, London (England).
F. Legge.
Civil Engineering Contractor (Johannesburg), Vol. 16, No. 10, p 31, 33, 35, 37-41 and 45, 1982. 18 Fig, 4 Tab.

Descriptors: *Design criteria, *Power conduits, *Tunnels, *Malawi, *Nkula Falls, Conduits, Tunnel construction, Geology, Rock properties, Tunnel linings, Weathering.

A case study is offered of the power conduit of the Nkula Falls hydroelectric scheme in Malawi. The geotechnical, design and constructional aspects are described of a tunnel 1.06 km in length with an excavated span of 9 m and 30 m cover in gneiss with significant discontinuity weathering. The scheme operates under a head of 58 m and the power conduit structure is 1.39 km in length, the first 330 m of which, linking the intake structure to the tunnel, are of reinforced concrete cut and cover construction. Jointing of the rock mass and associated weathering created difficult tunnelling conditions in the major part of the tunnel. Extensive use of temporary support measures was necessary for almost half the tunnel length. The tunnel lining sequence is described. (Baker-IVI)
W85-04819

CASE STUDY, POTABLE WATER RESERVOIR, TUKTOYAKTUK, NORTHWEST TERRITORIES,
Government of the Northwest Territories, Yellowknife. Water and Sanitation Section.
For primary bibliographic entry see Field 6A.
W85-04927

STEWART MOUNTAIN DAM CONCRETE CORE ANALYSIS - 1983,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
T. A. Gaeto.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-84-5, May 1984. 33 p, 11 Fig, 3 Tab, 2 Append.

Descriptors: *Concrete dams, *Compressive strength, Dams, Concrete mixes, Strength, Poisson ratio, In situ tests, *Arizona.

The results of testing approximately 280 feet of 6 inch diameter concrete core extracted from Stewart Mountain Dam, Arizona during the spring of 1982 are reported as part of a continuing effort to monitor the quality of the concrete in this structure. Stewart Mountain Dam is located 41 miles northeast of Phoenix, Arizona. The dam creates a reservoir with a capacity of 70,000 acre-feet. The construction records indicate a concrete mix with a high and wide ranged, water to cement ratio. Good concrete quality control and placement practices by today's standards were not employed throughout construction. The average compressive strength for all specimens tested was 5.25 lb/sq in, above average for mass concrete of this age. Average splitting tensile strengths seem high, at almost 500 lb/sq in. Specimens tested under rapid loading conditions, both compressive and splitting tensile, showed the concrete to be of consistently good quality. Modulus of elasticity and Poisson's ratio are normal for mass concrete, averaging 4.0 x 10 to the (6) power lb/sq in and 0.23 respectively. The movement of the dam since 1968 has been less than the potential indicated by laboratory measurements of expansions due to alkali-aggregate reactions. Based upon the continued reaction potential, monitoring of the dam through instrumentation should be continued. The standard method of core extraction and physical properties testing may never show the real problem, if in fact there is one. An alternative may be the use of state-of-the-art in-situ testing.
W85-04938

MEDIUM AND SMALL MASONRY ARCH DAMS IN CHINA,
Hangzhou Regional Center For Small Hydropower (China).
N. Zheng, and J. Lu.
International Water Power and Dam Construction, Vol. 37, No. 2, p 21-25, February, 1985. 10 Fig, 2 Tab.

Descriptors: *Dam construction, *Arch dams, *China (Peoples Republic), *Masonry dams, Construction materials, Concrete, Rocks, Hydroelectric power.

The masonry arch type is the most common type of dam used for small hydro projects (SHP) in China. This type of dam can be built using indigenous materials; it is economical and safe. Only a few machines are needed for construction and Chinese peasants are familiar with the technique of masonry placement. It is easier to pass floods over masonry dams under construction and proceed with construction during the rainy season. The various types of masonry dams seen in China include gravity arch, single curvature arch and double curvature arch dams. Also used are the massive head arch, multiple arch, hollow arch, hinge arch, two-storey arch, assembly arch, arch with multiple curvature and arch dams with peripheral joints. Specifics are given as to construction materials including rock, sands, cement mortar, fine gravel concrete, small-stone mortar, mixed mortar, and the strength of masonry. Spillway and energy dissipation and the control of seepage through the dam are also considered. (Baker-IVI)
W85-04950

8B. Hydraulics

RESERVOIR STORAGE EQUATION EXPERIMENTALLY VERIFIED,
Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Civil.
For primary bibliographic entry see Field 2E.
W85-04416

MATHEMATICAL MODELING OF HYDRAULIC REGIMES IN THE TRANSITION BETWEEN THE SURGE TANK AND CONDUITS OF A HYDROELECTRIC STATION,
N. N. Arshenevskii, V. V. Berlin, and O. A. Murav'ev.
Hydrotechnical Construction, Vol. 18, No. 3, p 105-110, March, 1984. 4 Fig, 2 Tab, 5 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 10-14, March, 1984.

Descriptors: *Mathematical modeling, *Hydraulics, *Hydroelectric plants, *Surge tanks, Computer models, Hydraulic design.

A computer model characterizing the hydraulic regimes of the transition between the surge tank and conduits of a hydroelectric station was developed as a design means to facilitate the processing of a large volume of data. This computer model allows analytical determination of the relationship between the specific energies of flows in the fork of a surge tank in the complete range of their hydraulic characteristics. It was established that the resistance coefficient of a transition between the surge tank and conduits is composed of a constant component depending on the geometry of the transition and a variable component depending on the type of discharges in the branches. Good agreement between predicted and observed values of specific energy of the transition between the surge tank and conduits was obtained. (Shieh-IVI)
W85-04419

HIGH-HEAD SPILLWAY WITH SWIRLING OF THE FLOW IN THE OUTLET SECTION,
For primary bibliographic entry see Field 8A.
W85-04420

KINEMATIC STRUCTURE OF FLOW IN A TRAPEZOIDAL CHANNEL,
E. K. Rabkova, V. I. Elfimov, and H. P. Martines.
Hydrotechnical Construction, Vol. 18, No. 3, p 124-128, March, 1984. 3 Fig, 1 Tab, 6 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 24-27, March, 1984.

Descriptors: *Channel erosion, *Erosion, *Hydraulics, Cross-sections, Channel shape, Model studies, Chezy equation.

Development of deformations in erodible channels is determined by the velocity characteristics of the flow interacting with the bed soils. In this paper, the results are reported of a study of the kinematic structure of the flow in trapezoidal channels. The objective was the determination of the cause of deformation of the canal slopes at standard (non eroding) mean flow velocity. The laboratory results indicate a considerable role of transverse turbulent eddy flow, i.e., secondary currents, in the formation of the kinematic structure of the flow. Under conditions of designing earth canals for a maximum permissible noneroding velocity, a trapezoidal channel shape is potentially unstable. In such channels, the velocity distribution over the width does not agree with Chezy calculation. To provide slope stability, the actual velocity distribution must be considered, and this leads to a decrease in the design velocity. The authors recommend the rejection of a trapezoidal shape in favor of a parabolic configuration. (Keenan-IVI)
W85-04421

EXPERIENCE IN THE OPERATION OF HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
For primary bibliographic entry see Field 8C.
W85-04423

DISCONTINUOUS WAVE ON STRETCHES OF AN ABRUPT EXPANSION OF A CANAL,
A. V. Mishuev, S. I. Levina, A. A. Gusev, and A. A. Seledkin.
Hydrotechnical Construction, Vol. 18, No. 4, p 137-142, April, 1984. 4 Fig, 5 Ref. Translated from Gidrotekhnichesko Stroitel'stvo, No. 4, p 6-9. April, 1984.

Descriptors: *Discontinuous waves, *Unsteady flow, *Canals, *Pumping, Diversion, Free-surface flow, Waves, Reverse bores, Dam failure, Gates, Velocity.

Design studies dealing with the diversion of part of the runoff of rivers to other areas call for the construction of long canals along which pumping stations will be constructed. The pumping stations are to be equipped with the largest modern hydraulic machinery, which will cause waves to be propagated along the canal. To provide trouble-free operation it will be necessary to thoroughly investigate problems related to unsteady flow. Results of studies are presented for one of the forms of the free surface (flow regime) characterized by the formation of a reversed bore on a wide stretch during supercritical flow in a narrow stretch, and also the results of an experimental investigation of wave formation in the case of complete instantaneous failure of a dam for the case of abrupt expansion of the lower pool. Two series of investigations were conducted. In the first series the discontinuous wave was formed in the narrow part of the flume by opening a gate and then propagating in the lower pool the wave interacted with the expansion. In the second series of studies the wave was formed by opening the gate immediately at the site of expansion. The theoretical solutions obtained agree satisfactorily with the results of the experimental investigations and can be used for preliminary estimations of the values of the depths and cross-sectional average velocities at characteristic sites. (Baker-IVI)
W85-04424

COMPARISON OF DYNAMIC FLOW ROUTING METHODS FOR URBAN DRAINAGE SYSTEMS (VERGLEICH HYDRODYNAMISCHER BERECHNUNGSANSATZE ZUR ABFLUBERMITTLUNG IN KANALNETZEN),
Karlsruhe Univ. (Germany, F.R.). Inst. fuer Siedlungswasserwirtschaft.
T. G. Schmitt, and H. H. Hahn.
Wasserwirtschaft, Vol. 74, No. 11, p 530-537, November, 1984. 7 Fig, 7 Tab, 20 Ref.

Descriptors: *Flow routing, *Urban drainage, Hydrodynamics, Storm wastewater, Pipes, Sewer systems, Mathematical equations, Hydraulic regime, Slope.

Four different methods of dynamic flow routing are described. They are widely used in sewer network design and in estimating stormwater overflow. The effects of frequently made simplifying assumptions in solving the dynamic flow equation is demonstrated for a single pipe and for three different sewer networks. Comparing the results obtained with simplified methods with those from a complete solution of the flow equations indicates that the acceptability of simplifications mainly depends on mean channel slope and volume and on the occurrence of special hydraulic regimes. This is particularly true if the system is surcharged or if control structures are activated. (Author's abstract)
W85-04627

SIMPLEST APPROXIMATE COMPUTATION OF DAM-BREAK WAVES (DIE EINFACHSTE NAHERUNGSBERECHNUNG VON DAMMBRUCHWELLEN),
Ingenieurburo, Aarau (Switzerland).
M. Herzog.
Wasserwirtschaft, Vol. 74, No. 12, p 583-585, December, 1984. 6 Fig, 2 Tab, 22 Ref.

Descriptors: *Dam failure, *Dam-break waves, *Mathematical equations, Malpasset, France, Waves, Flood waves.

A simple and clear mathematical method of approximation was developed to describe the dam-break wave at Malpasset, France that occurred in 1959. A simple procedure is possible even without consideration of the non-steady nature of the flow. The Malpasset reservoir had a capacity of 48 million cu m, practically all of which flowed out within an hour. The breach area was later calculated to be 3,700 sq m. With an energy level over the lowest point of the breach of 50 m, the first equation calculates a maximal flow of 42,100 cu m/sec, which is 3 times as high as average flow and 1,000 times as high as the bottom-outlet capacity. The new procedure calculated that the flood wave reached the town of Frejus after 22 minutes (21 minutes in reality) and that emptying of the reservoir lasted 59.5 minutes (61 minutes in reality). Accuracy was therefore excellent despite the fact that only one cross-section of the 9.3-km-long Reyran valley between the dam and Frejus was used for the computation. (Gish-IVI)
W85-04630

PRESSURE RISES DUE TO UNSTEADY FLOW, ESPECIALLY IN HIGH-LIFT NAVIGATION LOCKS (DRUCKERHOHUNGEN AUFGRUND INSTATIONARER STROMUNGSVORGANGE, INSBESONDERE IN SCHIFFSSCHLEUSEN MIT GROSSEN STUFENHOHEN),
Am Ruppurrer Schloss 5, 7500 Karlsruhe 51.
P. M. Schmelzle.
Wasserwirtschaft, Vol. 74, No. 12, p 586-591, December, 1984. 9 Fig, 3 Ref.

Descriptors: *Locks, *Unsteady flow, *Pressure, Mathematical equations, Hydraulic structures, Gates, Hydraulics.

A new mathematical procedure is described for calculating maximum pressure rise in navigation locks and similar hydraulic structures. A precondition of the procedure is that the lock is short enough and the closure times are long enough that elasticity influences can be disregarded. The system can then be seen as incompressible, and flow processes can be described with the aid of the Bernoulli equation for unsteady flow. These conditions are met by an emergency stop, in which the lock gate is stopped before it is fully open and is then closed, as was shown through studies of a model lock and experiments conducted at the operating lock. In hydraulic systems without oscillations in mass (no changes in water level within the system), maximal possible pressure rise before closure is independent of the opening process and depends only on the closing movement. Equations are give to calculate pressure rises for both linear closures (ideal closing process) and non-linear closures: in the former calculation, it is assumed that flow through the lock changes proportionally with time; while in the latter, the actual throttle effect of the gate at the end of the closure is determined, this being the deciding factor for the pressure rise. During non-linear procedures, the maximal pressure rise occurs either exactly at the moment of closure or immediately before it. Agreement between calculations using the new procedure and actual measurement was very good. (Gish-IVI)
W85-04631

HYDRAULIC MODELLING AT THE PIEDRA DEL AGUILA DAM,
Ecole Polytechnique Federale de Lausanne (Switzerland).
J. Bruschin.
International Water Power and Dam Construction, Vol. 37, No. 1, p 24-28, January, 1985. 7 Fig, 1 Tab, 12 Ref.

Descriptors: *Hydroelectric plants, *Hydraulic models, *Model studies, *Piedra del Aguila Dam, *Argentina, Dam construction, Design criteria, Cavitation.

Piedra del Aguila is a major hydroelectric scheme in Argentina. Extensive tests, aimed to help and check the design of the main hydraulic structures, were run for more than two years on five models at scales from 1:20 to 1:130. High priority problems were identified as: the river diversion and closure; spillway capacity, chute flows, hydraulic jump sweepout, jet impact location and flow aeration; bottom outlet free surface flows, aeration, jet impact location and discharge capacity at various reservoir levels during impoundment; erosion-deposition pattern of alluvium and weathered rocks at jet impact locations, back-water effects and their prevention and/or elimination; and, vibration risks of the very large spillway crest taintergates, specifically suppression of air entraining vortices. Much attention is given to the prevention of cavitation. (Baker-IVI)
W85-04781

8C. Hydraulic Machinery

EXPERIENCE IN THE OPERATION OF HYDRAULIC STRUCTURES AND EQUIPMENT OF HYDROELECTRIC STATIONS,
D. Z. Al'terman, and A. F. Dmitrukhin.
Hydrotechnical Construction, Vol. 18, No. 3, p 133-136, March, 1984. 5 Fig, 1 Tab, 2 Ref. Translated from Gidrotekhnechesko Stroitel'stvo, No. 3, p 34-36, March, 1984.

Descriptors: *Operating policies, *Hydroelectric plants, *Water hammer, Gates, Conduits, Costs.

Water hammer in pressure conduits occurring at hydroelectric stations following rapid unloading of the units can be reduced provided the turbine gate apparatus is closed according to a specially prescribed program. In this paper, an economical design of a programmed closing device is presented. The device can be readily retrofitted at existing installations. At various hydrostations the hammer pressure can be reduced by thirty to fifty percent of its existing value without an additional increase of speed when dropping the load. A decrease of water hammer in the conduits and the resultant reduction of working stresses in the casing will extend the permissible service life, reduce operating costs, and save metal on the repair and replacement of the conduits. (Keenan-IVI)
W85-04423

'RENNFELD' SMALL-SCALE HYDROELECTRIC POWER PLANT NEAR PFORZHEIM (KLEINWASSERKRAFTANLAGE 'RENNFELD' BEI PFORZHEIM),
Weber (Werner) G.m.b.H., Pforzheim (Germany, F.R.).
For primary bibliographic entry see Field 8A.
W85-04629

SPRINKLER DROPLET SIZE DISTRIBUTION ESTIMATION FROM SINGLE LEG TEST DATA,
Tennessee Univ., Knoxville. Dept. of Agricultural Engineering.
R. D. von Bernuth, and J. R. Gilley.
Transactions of the American Society of Agricultural Engineers, Vol. 27, No. 5, p 1435-1441, September-October, 1984. 9 Fig, 4 Tab, 26 Ref.

Descriptors: *Fluid drops, *Size distribution, *Sprinklers, Estimation, Ballistics, Nozzles, Pressure.

Droplet size distribution data from agricultural sprinklers are useful for predicting evaporation, wind drift, and droplet effects on the soil. Collecting droplet size distribution data is tedious and expensive, so a method of estimating such data from existing or routinely collected data would be useful. The theory and technique for estimating such data using droplet ballistics are described whereby droplet size data can be estimated from routinely collected single leg data. The model was tested for five sets of conditions including three nozzle sizes and three pressures and proved to fit published droplet size data very well. The distribu-

tions produced by the estimation technique are presented. (Author's abstract)
W85-04745

CONVERT THE BROOK ON YOUR FARM TO ELECTRIC CURRENT,
Pretoria Univ. (South Africa). Dept. of Agricultural Engineering.
J. H. Eckard.
Deciduous Fruit Grower (Cape Town), Vol. 32, No. 1, p 287-289, 1982. 1 Tab.

Descriptors: *South Africa, *Electric power generation, *Farms, *Streams, Hydroelectric power, Centrifugal pumps, Hydroelectric generators, Power requirements.

To determine whether a stream is suitable for generating electricity, three very important requirements must be examined. If the stream is not a perennial the number of months it can be counted on must be determined. The sufficiency of the water flow to convert economically to the generation of electricity must be considered. The pressure head in the stream must be examined. Instructions are supplied on how to build your own generator and the amount of current needed. (Baker-IVI)
W85-04813

HEATING ENCLOSED WASTEWATER TREATMENT FACILITIES WITH HEAT PUMPS,
Cold Regions Research and Engineering Lab., Hanover, NH.
For primary bibliographic entry see Field 6A.
W85-04924

UNDERGROUND UTILITIES IN BARROW, ALASKA,
Moolin (Frank) and Associates, Anchorage, AL.
For primary bibliographic entry see Field 6A.
W85-04925

SEWAGE PUMP STATION DESIGN FOR BARROW, ALASKA,
Moolin (Frank) and Associates, Anchorage, AL.
W. A. Robertson, and R. W. Martin.
In: Proceedings of the Third Symposium on Utilities Delivery in Cold Regions, Edmonton, Alberta, May 25-26, 1982. Environmental Protection Service, Ottawa, Ontario, Report EPS-3-WP-82-6, December 1982. p 383-400, 6 Fig, 1 Tab.

Descriptors: *Sewer systems, *Utilities, Wastewater treatment, Cold regions, Arctic regions, *Alaska, Pumping plants, Permafrost, Design criteria, Underground structures.

The development of the pump stations to connect the underground utilidor system in Barrow, Alaska is presented. These underground pump stations are the first large scale underground structures in permafrost that are utilized strictly for a community utility system. The geotechnical firms of Harding-Lawson Associates, Woodward-Clyde Consultants and EBA Engineering Consultants, Limited participated in the design of the pump station structure. The systems have been designed to be as redundant as possible and as maintenance free as any mechanical system can be. The designers of the Barrow pump stations, Frank Moolin and Associates and Robertson and Associates, feel that the system as designed is a cost-effective means of meeting the owner's requirements for the underground utilidor system. Excavation for the pump station is in progress; it is estimated that the first pump station foundation will be completed by May 1982.
W85-04926

8D. Soil Mechanics

RISK OF DAMAGE AND FAILURE OF EARTH DAMS,
M. I. Gogoberidze, Yu. N. Mikashvili, G. A. Beruchashvili, and M. E. Gviliya.
Hydrotechnical Construction, Vol. 18, No. 4, p 177-181, April, 1984. 4 Fig, 1 Tab, 6 Ref. Translated from Hydrotechnical Construction, No. 4, p 35-58, April, 1984.

Descriptors: *Earth dams, *Dam failure, Reservoirs, Dam design, Dam construction, Reservoir operation.

An analysis of the data on damages and failures of earth dams shows that the causes of the decrease of their reliability can be divided into the following main groups: survey-research - unsatisfactory quality of surveys at the dam site, mistakes made in selecting the type of dams and in their research; design - errors made when designing individual components or structure as a whole, wrong choice of construction materials and construction technology; construction - low standards of construction works, use of inferior materials, imperfect supervision of construction and assembly works; and operational - insufficient skill of the operating personnel, difficult operating conditions. In view of the fact that the degree of risk is estimated on the basis of a statistical analysis of data on incidents that occurred during construction and operation of dams, it is advisable not to differentiate individual factors influencing the reliability of dams, but rather to examine their joint effect on the structure. (Baker-IVI)
W85-04430

PREDICTION AND CONTROL OF GROUND MOVEMENT ASSOCIATED WITH TRENCH EXCAVATION,
Water Research Centre, Swindon (England). Swindon Engineering Centre.
R. H. Fry, and P. B. Rumsey.
Water Pollution Control, Vol. 82, No. 2, p 151-163, 1983. 9 Fig, 2 Tab, 11 Ref.

Descriptors: *Excavation, *Trenches, *Ground movement, Ditches, Earthworks, Soil properties, Design criteria, Pipelines, Sewer systems.

Excavation of trenches for sewers and other deep pielines causes ground movement which can damage adjacent pipelines, road-pavements and buildings. Practical methods of controlling ground movement are discussed, and the role of ground movement prediction and control in the NWX/BGC Model Consultative Procedure for Pipeline Construction involving deep excavation is described. Work is continuing on the analysis and interpretation of field experiments to measure ground movement caused by trenching. It is unrealistic to expect that movement and pipe strain caused by trench excavation will ever be reliably predicted to a high degree of accuracy. Apart from the inherent variability of soil deposits, and therefore soil properties, and the effect of small changes in site construction procedure, unexpected variations in near-surface ground conditions, particularly those occasioned by old backfilled trenches for utilities, and surcharge effects from traffic loading and spoil heaps, can lead to movements which are considerably different from those predicted. It is possible to make meaningful assessment of the range of ground movement to be expected in a given situation. (Baker-IVI)
W85-04516

CLOSED FORMULAE FOR EARTHQUAKE-INDUCED DEFORMATIONS IN DAMS,
Consulting Engineer, Aarau, Switzerland.
A. M. Herzog.
International Water Power and Dam Construction, Vol. 37, No. 1, p 33-34, January, 1985. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Dam stability, *Earthquakes, *Deformation, Mathematical equations, Embankments, Earth dams.

In March of 1979 an earthquake of 7.6 magnitude on the Richter scale affected two embankment dams on the Balsas river in Mexico near the pacific Coast. Both dams were generously equipped with measuring instruments. The records obtained permitted the subsequent calibration of different calculation methods for predicting deformations in dams from earthquakes. Realistic values for the earthquake-induced deformations of dams and embankments are shown to be predictable with simple, closed formulae, based either on the well known shear-beam method, or on a simple earth column. The results obtained from the simple, closed formulae are far more realistic than those rendered by the much more fashionable and expensive finite element methods. (Baker-IVI)
W85-04782

URIBANTE-DORADAS HYDRO DEVELOPMENT IN VENEZUELA,
CEH Ingenieros Consultores, Caracas (Venezuela).
For primary bibliographic entry see Field 8A.
W85-04783

8E. Rock Mechanics and Geology

UNLINED HIGH PRESSURE TUNNELS IN AREAS OF COMPLEX TOPOGRAPHY,
Norges Tekniske Hoegskole, Trondheim. Dept. of Geology.
For primary bibliographic entry see Field 8A.
W85-04412

ECONOMIZING THE DIAMETER OF TUNNELS,
Pipe and Canal Services A.G., Zumikon (Switzerland).
For primary bibliographic entry see Field 8A.
W85-04413

MALAWI - DRIVING A 9 M DIAMETER POWER CONDUIT WITH LOW COVER AT NKULA FALLS,
Watermeyer, Legge, Piesold and Uhlmann, London (England).
For primary bibliographic entry see Field 8A.
W85-04819

8F. Concrete

LONG-TERM PRESTRESS IN CONCRETE-LINED PRESSURE TUNNELS,
Golder Associates, Inc., Bellevue, WA.
L. P. Gonano.
International Water Power and Dam Construction, Vol. 36, No. 11, p 28-33, November, 1984. 5 Fig, 12 Ref.

Descritors: *Tunnel linings, *Creep, *Concretes, Prestressed concrete, Tunnels, Linings, Algorithms, Design criteria.

The limited understanding of the creep behavior of concrete-lined underground structures and the complexities of analysis of material creep have to date effectively deterred rigorous methods of analysis and reliance on creep behavior as a significant and practical design aspect. A simple, accurate and practical analysis algorithm was developed for a symmetrical two-dimensional structure such as a concrete-lined tunnel. It incorporates both the time-dependent creep behavior of the concrete and rock and the structural interaction of the composite structure. It allows all the unknown and complex factors associated with creep to be grouped into a limited number of parameters which can be deduced or checked by back-analysis from the prototype structure. It also allows for simplified methods of design, construction control and design verification to be applied without attendant sacrifices in accuracy. The use of the structural creep model has allowed an explicit consideration of creep in the design of prestressed concrete linings and thereby extended the range of applications for which prestressed linings may be designed. (Baker-IVI)
W85-04414

Group 8F—Concrete

DETERMINATION OF CERTAIN RHEOLOGICAL CHARACTERISTICS OF CONCRETE MIXES BY SHEAR TESTING,
G. T. Mikeladze.
Hydrotechnical Construction, Vol. 18, No. 4, p 142-145, April, 1984. 3 Fig, 2 Tab, 3 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 4, p 10-11, April, 1984.

Descriptors: *Concretes, *Rheology, Shear stress, Workability, Strength, Slump test, Stiffness, Concrete additives, Mortar.

One of the main concepts of rheology of concrete mixes is their workability, determined as fluidity according to the slump test (centimeters) or stiffness (seconds). These adopted criteria of workability are only an external manifestation of internal processes occurring in the concrete mix. An attempt was made to determine these internal relations, in which case the shear stresses were taken as objects of rheological measurements, from which the characteristics of internal friction and cohesion were determined. The experiments established that the use of a combined additive retarded the formation of internal bonds and gaining of strength of concrete for a long time. Therefore, mortars and concrete mixes with combined additives have increased workability compared with mixes without additives or with a single additive. (Baker-IVI)
W85-04425

PRESENT TECHNIQUES FOR 'IN-SITU' SEWER RENOVATION,
North West Water Authority, Warrington (England).
R. S. Anderson.
Water Pollution Control, Vol. 82, No. 2, p 179-187, 1983.

Descriptors: *Sewer systems, *Renovation, Hydraulic engineering, Pipes, Linings, Construction, Cement, Plastics, Concrete, Grouting.

Techniques for renovation cannot be developed in isolation. They must be considered as part of a strategic plan encompassing the selection of critical lengths, programmed inspection, an assessment of hydraulic and structural suitability and an examination of the economic and environmental variability of renovation against that of renewal. The ideal renovation system would be one capable of achieving the following objectives: all work capable of being performed through existing manholes without the need for specific excavations; ability to cope with re-making of existing drain connexions without excavation; rapid installation reducing both cost and disruption; substantial cost saving against renewal; extended life comparable with that of renewal; and no loss of hydraulic capacity. Renovation systems described in some detail include slip lining, insituform, lining with segments and panels, glass-reinforced cement, glass-reinforced plastic, precast concrete linings, and polyester-resin concrete. Discussion is also offered of insertion of new pipes, pressure pointing, joint sealing, and grouting of linings. (Baker-IVI)
W85-04518

PARKER DAM CONCRETE CORE INVESTIGATIONS,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
E. R. Dunstan.
Available from the National Technical Information Service, Springfield, VA 22161. USBR Report REC-ERC-82-20, August 1983. 40 p, 4 Fig, 4 Tab, 18 Ref, 1 Append. Contract/Grant No. 2-01-DV-00158.

Descriptors: *Compressive strength, *Concrete dams, *Poisson ratio, *Alkali-aggregate reactions, *Modulus of elasticity, Concretes, Strength, Parker Dam, Core data, Arizona, Dam safety, Colorado River.

This report is a review of physical property tests and petrographic examinations of concrete cores from Parker Dam. Cores were taken from the dam in 1938, 1940-41, 1945, 1949, 1956 and 1980, following the onset of visible cracking due to alkali-aggregate reaction. Test data from 1980 cores are reported and compared to earlier core data. The concrete from Parker Dam was, in most cases, stronger in 1980 than when completed in 1938. There were apparent strength reductions in the top portions of the dam from 1938 to 1956, with a rebound in strength since that time. Evidence of alkali-aggregate reaction was found throughout the dam as substantiated by the petrographic analysis. Further evidence was the reduction in modulus of elasticity at all elevations in Parker Dam, although a rebound in modulus of elasticity appears to occur in recent years. The alkali-aggregate reaction is most severe in the upper portions of the dam, resulting in a higher incidence of disbonded construction joints. Assuming that most of the reactive silica and alkalies have been consumed, very little future deterioration will take place as the result of alkali-aggregate reaction.
W85-04935

FLY ASH AND FLY ASH CONCRETE,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
B. R. Dunstan.
Available from the National Technical Information Service, Springfield, VA 22161. Report REC-ERC-82-1, May 1984. 42 p, 32 Fig, 11 Tab, 45 Ref. Contract/Grant No. 10781 V0195.

Descriptors: *Concrete additives, *Concrete mixes, *Concrete technology, *Concretes, Fly ash, *Cements, Concrete testing, Construction materials, Portland cements, Pozzolans, Abrasion, Backfill, Freeze-thaw tests, Calcium, Elastic properties.

Twenty-one samples of both F and C type fly ashes were examined as replacements for portland cement in concrete. A new cement was also developed that consists of over 90% fly ash and anhydrous CaSO4. The nonportland cement concrete showed very good compressive strengths and good resistance to sulfate. Excellent freeze-thaw durability was obtained using 90% fly ash concretes in which proper air entrainment was achieved. High Ca ashes plus CaSO4 can be used to produce low-strength backfill and subbase concrete. The concrete produced from 90% or more fly ash displayed low-surface abrasion resistance possibly due to surface carbonation. The elasticity of fly ash concrete is similar to that of ordinary portland cement. The drying shrinkage of fly ash concrete normally is less than that of ordinary cement concrete.
W85-04936

8G. Materials

PRESENT TECHNIQUES FOR 'IN-SITU' SEWER RENOVATION,
North West Water Authority, Warrington (England).
For primary bibliographic entry see Field 8F.
W85-04518

LONG-TERM GROUNDWATER PROTECTION WITH PLASTIC LININGS (LANGFRISTIGER GRUNDWASSERSCHUTZ MIT KUNSTSTOFF-DICHTUNGSBAHNEN),
Beratender Ingenieur fur Kunststofftechnik im Bauwesen. Schwerpunkt: Wasserbau, Grundwasserschutz, Erd- und Grundbau.
For primary bibliographic entry see Field 5G.
W85-04633

RESPONSES OF LAKE WHITEFISH (COREGONUS CLUPEAFORMIS) TO FERTILIZATION OF LAKE 226, THE EXPERIMENTAL LAKES AREA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
For primary bibliographic entry see Field 8I.
W85-04840

INVESTIGATION INTO THE FAILURE OF A PRESTRESSED ROCK ANCHOR,
Statens Vattenfallsverk, Vaellingby (Sweden).
G. Jurell.
International Water Power and Dam Construction, Vol. 37, No. 2, p 45-47, February, 1985. 4 Fig, 3 Ref.

Descriptors: *Mechanical failure, *Rock anchors, Sweden, Grundfors hydropower station, Construction, Grouting, Corrosion, Intergranular stress.

During construction of the Grudfors hydropower station in 1955, 118 prestressed rock bolts were installed to support the load from an overhead crane. In 1981, one of these 26 year old bars failed without warning and part of it was ejected at high speed from the hole in which it had been installed. The ejected part of the bar was superficially corroded along its entire length and only traces of grout could be seen. The 2.5 m length of the bar was bent 24 mm out of true. While it was not possible to gain a clear picture of the details of the grouting process used when the bars were installed, one notable fact is the absence of grouting pipes. It is possible that grooves in the anchorage plates had some part to play in the process. Even the original anti-corrosion protection given to the bars can not be proved to have been satisfactory. A further investigation showed that more than half the bars investigated were unsatisfactorily grouted or were damaged in some respect. The material the bars were made of was sensitive to cracking. The primary cause of the failure that occurred was probably inter-granular stress corrosion. The factor of safety against new brittle failure was judged to be low. The load-bearing capacity was restored by installing 232 new unstressed rock bolts in drilled holes followed by grouting. (Baker-IVI)
W85-04952

RECENT DEVELOPMENTS IN LEAK NOISE CORRELATION TECHNIQUES,
J. Oliver.
Water Services, p 512-513, December, 1984. 3 Fig, 1 Ref.

Descriptors: *Pipelines, *Leak detection, *Noise correlation, Water loss, Leakage.

Probably the most significant contribution in recent years to the detection and accurate location of leaks from buried pipelines has been made by the leak noise correlation method. Traditional listening methods seek to locate by identifying the position of maximum leak noise intensity, but often this position does not coincide with the actual leak position. Correlators use not sound intensity but sound similarity involving the properties of noise production, propagation and permanence in time as the basis of their operation. Noise produced by a leak can be said to be random in that the noise is not similar at any time internal. At different points in a uniform pipeline, propagation of noise takes place at the same velocity regardless of the distance of the points from the leak. The permanence in time of leak noises allows the correlator processing period to discriminate against parasitic and transitory noises. Correlators determine the time difference between similar noise patterns reaching two sensors positioned at opposite ends of a section of pipeline in which leakage has been identified. With the input of the measured distance between the sensors and a value for the velocity of sound for the particular pipeline, the correlator computes the leak position from a mathematical equation. (Baker-IVI)
W85-04958

8I. Fisheries Engineering

CONFINEMENT AND WATER QUALITY-INDUCED STRESS IN LARGEMOUTH BASS,
National Fish Hatchery and Technology Center, San Marcos, TX.
For primary bibliographic entry see Field 5C.
W85-04680

EFFECT OF WATER TEMPERATURE ELEVATION ON INCIPIENT AND CUMULATIVE FE-

FECUNDITY OF BATCH-SPAWNING TENCH, TINCA TINCA (L.),
Instytut Rybactwa Srodladowego, Warsaw (Poland). Heated Water Lab.
B. Morawska.
Aquaculture, Vol. 42, No. 3/4, p 273-288, December 1, 1984. 3 Fig, 6 Tab, 30 Ref.

Descriptors: *Water temperature, *Fish, *Tench, *Aquaculture, *Fish farming, Spawning, Fish eggs, Fish ponds, Fish hatcheries.

The fecundity of 131 tench (Tinca tinca L.) from heated and control ponds was evaluated in the years 1974, 1975 and 1977. There were differences in the temperature of both types of pond and these varied with the season and also with the year. The reproductive season began 1 month earlier in the heated ponds, but it ended almost simultaneously in the two types of pond. In the control ponds tench deposited 3-4 batches of spawn during the season, and in the heated ones 5-8 batches. There were significant differences in fecundity between successive batches during the season, for the population of the heated ponds. Heating the water did not change mean batch fecundity which varied between 38,000 and 52,000 oocytes. Incipient fecundity (number of oocytes before first spawning) was also similar in both types of pond. The cumulative fecundity (the total number of oocytes deposited by the average female over the reproductive season) of females from the heated ponds was on average higher by 38.6-91.8%. Temperature patterns over the prespawning and spawning period exerted a determining effect on the number and fecundity of the successive batches and on cumulative fecundity during the season. (Author's abstract)
W85-04707

FACTORS INFLUENCING IMPINGEMENT OF FISH BY LAKE ONTARIO POWER PLANTS,
Hartwick Coll., Oneonta, NY. Dept. of Biology.
R. L. Wyman, and R. S. Dischel.
Journal of Great Lakes Research, Vol. 10, No. 4, p 348-357, 1984. 4 Fig, 3 Tab, 25 Ref.

Descriptors: *Lake Ontario, *Powerplant intakes, *Intake gates, *Fish behavior, *Impingement, Thermoclines, Water temperature, Fish populations.

Fish impinged by two Lake Ontario power plants were examined to determine the causal factors. Fish were near shore because they resided there, migrated there to spawn or forage, or because the water mass in which they resided moved near shore. Once near shore, fish abundance in impingement collections was correlated with demersal or pelagic behavior. Periodic increases in diversity and abundance of impinged fish corresponded with times of upwelling and thermocline oscillations. These data suggest that some species were segregated along temperature gradients and were impinged when the thermocline passed near the intake. Comparisons of impingement catch between two power plants, one withdrawing a constant volume of water and the other a varying volume, showed that responses of fish to an intake were of three kinds. Alosa pseudoharengus and Osmerus mordax were apparently attracted to water currents entering the intake. Morone americana, Morone chrysops, Dorosoma cepedianum, and Perca flavescens were not influenced by changes in flow rate, suggesting that their impingement was proportional to their density in nearshore water. Micropterus dolomieui avoided the intake at higher flow rates in part due to rheotactic behavior. (Author's abstract)
W85-04713

RESPONSES OF LAKE WHITEFISH (COREGONUS CLUPEAFORMIS) TO FERTILIZATION OF LAKE 226, THE EXPERIMENTAL LAKES AREA,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
K. H. Mills.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 1, p 129-138 January, 1985. 4 Fig, 5 Tab, 53 Ref.

Descriptors: *Whitefish, *Fertilizers, *Lakes, Ontario, Growth, Reproduction, Nitrogen, Phosphorus, Carbon, Nutrients, Fish food organisms.

Intentional fertilization of ponds and lakes to increase fish yield has a long history, but little is known about the responses of a northern fish population, composed largely of older, sexually mature individuals, to nutrient addition. The responses of an unexploited population of lake whitefish (Coregonus clupeaformis) to fertilization of Lake 226 (L226), the Experimental Lakes Area, northwestern Ontario, were measured for 4 yr (1973-77). A vinyl sea curtain separated the lake into a northeast (NE) basin, which received P, N, and and C additions, and a southwest (SW) basin, which received only N and C additions. Six population parameters were monitored throughout the study: growth, condition, abundance, survival, fecundity, and production. Lake whitefish in the NE basin grew faster, had higher coefficients of condition, and had greater recruitment and production than those in the SW basin during the 2nd through 4th yr of fertilization. No differences between basins were detected in annual survival for fish > or = age 1, but survival of age 0 fish was greater in the NE basin. Whitefish production in L226NE averaged twice that in L226SW from the 2nd to the 4th yr of fertilization, though significant variations occurred between years in both the NE and SW populations. The whitefish in L226SW apparently did not respond to nitrogen and carbon fertilization. The increased growth and higher condition of L226NE whitefish was apparently due to an increase in the primary prey items, chironomids and chaoborids, which in turn was related to an increase in their food supply. (Moore-IVI)
W85-04840

RESPONSES OF BENTHIC MACROINVERTEBRATE SPECIES TO MANIPULATION OF INTERSTITIAL DETRITUS IN CARNATION CREEK, BRITISH COLUMBIA,
Calgary Univ. (Alberta). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W85-04841

RESPONSES OF SOCKEYE SALMON (ONCORHYNCHUS NERKA) TO FERTILIZATION OF BRITISH COLUMBIA COASTAL LAKES,
Department of Fisheries and Oceans, Nanaimo (British Columbia). Pacific Biological Station.
K. D. Hyatt, and J. G. Stockner.
Canadian Journal of Fisheries and Aquatic Sciences, Vol. 42, No. 2, p 320-331, February, 1985. 9 Fig, 6 Tab, 43 Ref, 1 Append.

Descriptors: *Fertilizers, *Salmon, *Fish management, *British Columbia, Nitrogen, Phosphorus, Zooplankton, Fish food organisms, Smolt.

The coastal lakes of this study have extremely low phosphorus concentrations, short water residence time, and extreme oligotrophic condition. Faunistically the coastal lakes are characterized by low species diversity and low standing crops with respect to both zooplankton and fish communities. Addition of nitrogen and phosphorus fertilizer, using a DC6B aerial tanker, to several British Columbia coastal lakes resulted in increased autotrophic and heterotrophic production and larger standing stocks of zooplankton. These changes at the primary and secondary trophic levels are reflected by increased in-lake growth of juvenile sockeye salmon and larger outmigrant smolts. Smolt size changes in fertilized lakes may lead to increases in the harvestable surplus of sockeye adults by promoting both increases in marine survival and an earlier age-at-return to the fishery. (Moore-IVI)
W85-04847

ATTRACTION OF FISH TO MERCURY VAPOUR LIGHT AND ITS APPLICATION IN A GENERATING STATION FOREBAY,
Ontario Hydro, Toronto. Research Div.
G. T. Haymes, P. H. Patrick, and L. J. Onisto.
Internationale Revue der Gesamten Hydrobiologie, Vol. 69, No. 6, p 867-876, 1984. 7 Fig, 2 Tab, 7 Ref.

Descriptors: *Fish behavior, *Mercury vapor lights, *Fish handling facilities, *Forebays, Thermal powerplants, Cooling water, Alewife, Shad, Smelt, Fish conserving pumps, Strobe lights, Lights.

Many thermal generating stations on the Great Lakes use once-through cooling systems in which water is drawn from the lake into a forebay before passing through the station. In order to reduce fish losses at these generating stations, fish conserving pumps or other means could be used to remove live fish from the forebay to be returned to the lake. Laboratory and field tests were conducted to determine the effectiveness of filtered mercury vapor lights in attracting fish as part of fish conserving schemes. In laboratory tests, alewife demonstrated an attraction to the mercury vapor light which was associated with an increase in swimming activity. This response was maintained over a 48-hour period. When the filtered mercury vapor lights were used in association with a fish pump in a forebay, juvenile gizzard shad and smelt were attracted to the pump area. There was variation with time of day, turbidity and lighting array, but the number of fish passing through the pump increased when the mercury vapor lights alone or when the mercury lights were used in association with a white strobe light. (Moore-IVI)
W85-04914

SUBJECT INDEX

ABU DHABI
Treatment of Sewage for Use in Municipal Irrigation in Abu Dhabi, UAE,
W85-04464 5D

ACID DEPOSITION
Changes in Base Cation Concentrations Due to Freshwater Acidification,
W85-04532 5C

Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry,
W85-04792 5C

Acid Deposition Control, A Benefit-Cost Analysis: Its Prospects and Limits,
W85-04798 6B

ACID LAKES
Changes in Base Cation Concentrations Due to Freshwater Acidification,
W85-04532 5C

Efficiency of Liming in Acid, Humus-Influenced Lakes,
W85-04533 5G

Short-term Effects of Liming on Sediment Oxygen Uptake in an Acid lake,
W85-04537 5G

Acidified Lakes: Ecosystem Response Folowing Sediment Treatment with Sodium Carbonate,
W85-04539 5G

ACID MINE DRAINAGE
Vascular Riffle Flora of Appalachian Streams: The Ecology and Effects of Acid Mine Drainage on Justicia americana (L.) Vahl,
W85-04884 5C

ACID PRECIPITATION
Spatial Distributions of Precipitation Acidity and Major Ion Wet Deposition in North America During 1980,
W85-04647 5B

Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

ACID RAIN
Organic Acidity in Precipitation of North America,
W85-04499 5B

Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

Composition of Precipitation on Amsterdam Island, Indian Ocean,
W85-04503 5B

Analysis of Precipitation Collected on a Sequential Basis,
W85-04505 5B

Spatial Distributions of Precipitation Acidity and Major Ion Wet Deposition in North America During 1980,
W85-04647 5B

Acid Rain: Dousing Community Resources,
W85-04750 5F

Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes,
W85-04789 5C

ACID STREAMS
Survival of Eggs and Alevins of Atlantic Salmon (Salmo salar) in Relation to the Chemistry of Interstitial Water in Redds in Some Acidic Streams of Atlantic Canada,
W85-04845 5C

ACIDIFICATION
Evaluation of Acidification Based on Former Colorimetric Determination of pH: The Effect of Indicators on pH in Poorly Buffered Water,
W85-04530 5A

Conceptual Model of Lake Acidification,
W85-04531 5C

Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

ACTIVATED ALGAE
Nitrogenous Wastewater Treatment by Activated Algae,
W85-04967 5D

ACTIVATED SLUDGE
Adsorption and Complexation Mechanisms of Heavy Metal Uptake in Activated Sludge,
W85-04411 5D

Quantitative Estimation in COD Units of Refractory Organic Compounds Produced by Activated Sludge Microorganisms,
W85-04486 5D

ACTIVATED SLUDGE PROCESS
Optimization of Coleshill Activated-Sludge Plant Operating Conditions,
W85-04590 5D

ADSORPTION
Adsorption and Complexation Mechanisms of Heavy Metal Uptake in Activated Sludge,
W85-04411 5D

Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides,
W85-04757 5B

Effects of Dissolved Organic Carbon on the Adsorption Properties of Plutonium in Natural Waters,
W85-04799 5B

AERATION
Pilot-Plant Evaluation of a Deep Shaft Linked to Conventional Aeration Without Inter-Stage Settlement to Give a Fully-Nitrified Effluent,
W85-04452 5D

Changes in the Oxygen Balance of a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Zuurstofbalans van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04889 5G

Changes of Organic and Inorganic Nitrogen in a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Organische en Anorganische Stikstof van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04890 5G

AERATION POROSITY
Relationships among Oxygen Flux, Soil Water Tension, and Aeration Porosity in a Drying Soil Profile,
W85-04956 2G

AERIAL PHOTOGRAPHY
Small Format, Hand Held Helicopter Based Photography for Monitoring Industrial Water Effluent Plumes,
W85-04586 7B

AEROBIC BACTERIA
Effect of Effluent High in Chromium on Marine Sediment Aerobic Heterotrophic Bacteria,
W85-04869 5C

AEROBIC DIGESTION
Aerobic Treatment in 'Oxitron' Biological Fluidized Bed Plant at Coleshill,
W85-04593 5D

AGGREGATE STABILITY
Method of Measuring Aggregate Stability Under Waterdrop Impact,
W85-04733 2J

AGRICULTURAL CHEMICALS
System of Practices for Preventing Water by Agricultural Chemicals,
W85-04619 5G

AGRICULTURAL RUNOFF
Runoff and Sediment Transport Within and From Small Agricultural Watersheds,
W85-04734 2J

AGRICULTURAL WATERSHEDS
Nutrient Budgets for Agricultural Watersheds in the Southeastern Coastal Plain,
W85-04826 6G

AIR-WATER INTERFACES
Retrieval of Material from the Surface Microlayer with Screen and Plate Samplers and its Implications for Partitioning of Material within the Microlayer,
W85-04895 5A

ALACHLOR
Alachlor Toxicity to a Freshwater Teleost Clarias batrachus,
W85-04885 5C

ALAJUILA WATERSHED
Controlling Erosion and Sedimentation in the Panama Canal Watershed,
W85-04442 4D

ALASKA
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

Status of Sanitation Facilities in Alaska - 1982,
W85-04915 6B

Water Conservation in Barrow, Alaska,
W85-04918 6B

Operation and Maintenance Considerations for the Design of Arctic Water Systems,
W85-04923 6A

Underground Utilities in Barrow, Alaska,
W85-04925 6A

Sewage Pump Station Design for Barrow, Alaska,
W85-04926 8C

ALBERTA
Trees Scars to Determine the Frequency and Stage of High Magnitude River Ice Drives and Jams, Red Deer, Alberta,
W85-04589 7B

Modelling Winter Oxygen Depletion Rates in Ice-Covered Temperate Zone Lakes in Canada,
W85-04843 2H

ALDEHYDES
Trace Determination of Aldehydes in Water by High-Performance Liquid Chromatography,
W85-04622 5A

ALFALFA
Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
W85-04727 2D

ALGAE
Effects of Motorway Run-Off on the Ecology of Stream Algae,
W85-04466 5C

Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions,
W85-04498 5F

Availability of Sediment P in Lake Lugano,
W85-04563 2H

Some Remarks on the Ecology of Algae in Heated Waters (Uwagi o ekologii glonow w wodach podgrzanych),
W85-04609 5C

Short-Term Uptake of Heavy Metals by Periphyton Algae,
W85-04721 5B

Cellular Phosphorus Concentration as a Criterion for Trophic Status in Rapidly Flushed Lakes,
W85-04846 2H

Experimental Lake Fertilization in the Kuokkel Area, Northern Sweden. Phytoplankton Biomass and Algal Composition in Natural and Fertilized Subarctic Lakes,
W85-04910 2H

ALGAE CONTROL
Biomanipulation Experiment in Green Lake, Seattle, Washington,
W85-04671 5G

ALGAL GROWTH
Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04898 5A

ALGORITHMS
Algorithms for Optimizing Hydropower System Operation,
W85-04786 4A

ALKALI-AGGREGATE REACTIONS
Parker Dam Concrete Core Investigations,
W85-04935 8F

ALKALINE PHOSPHATASES
Influence of Light on the Alkaline Phosphatase Activity of Selenastrum capricornutum (Chlorophyceae) in Streams,
W85-04849 2H

ALTITUDE
Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

AMAZON FLOODPLAIN
Amazon Floodplain Lakes: Shape, Fetch, and Stratification,
W85-04568 2H

Vertical Mixing in Amazon Floodplain Lakes,
W85-04569 2H

Nutrient Processing in Amazon Floodplain Lakes,
W85-04571 2K

AMERICIUM
Measurement of Particulate Association of Americium in Freshwater,
W85-04491 5A

AMSTERDAM ISLAND
Composition of Precipitation on Amsterdam Island, Indian Ocean,
W85-04503 5B

ANAEROBIC CONDITIONS
Performance Characteristics of the Anaerobic Baffled Reactor,
W85-04495 5D

Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

ANAEROBIC DIGESTION
Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

Anaerobic Treatment of Concentrated Industrial Wastewater,
W85-04877 5D

ANIMAL WASTES
Detoxification of Effluents in a Macrophyte Treatment System,
W85-04489 5D

Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

Irrigation of Swine Lagoon Effluent onto Pine and Hardwood Forests,
W85-04741 5D

ANTARCTIC
Use of Icebergs to Supply Water (Die Verwendung von Eisbergen zur Wasserversorgung),
W85-04625 3B

Thickness of Ice on Perennially Frozen Lakes,
W85-04883 2C

AQUACULTURE
Effect of Water Temperature Elevation on Incipient and Cumulative Fecundity of Batch-Spawning Tench, Tinca tinca (L.),
W85-04707 8I

AQUATIC BACTERIA
Temperature-Growth Rate Relationships of Aerobic Heterotrophic Bacteria Isolated from a Silt-laden Impoundment,
W85-04815 2H

AQUATIC ENVIRONMENT
Physical Model of the Aquatic Ecosystem,
W85-04850 2H

AQUATIC HABITATS
Relationships Between Woody Debris and Fish Habitat in a Small Warmwater Stream,
W85-04679 2E

AQUATIC INSECTS
Qualitative and Quantitative Entomofaunistic Investigation of an Opencast Residual Lake near Leipzig (GDR),
W85-04906 2H

AQUATIC PLANTS
Detoxification of Effluents in a Macrophyte Treatment System,
W85-04489 5D

Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

Possible Relationships Between Surface Water Chemistry and Aquatic Plants in the Northern Great Plains,
W85-04697 2H

AQUATIC WEED CONTROL
Phytoplankton Responses to Reduction and Elimination of Submerged Vegetation by Herbicides and Grass Carp in Four Florida Lakes,
W85-04857 5G

Biology of Brachycentrus subnubilus Curtis (Trichoptera) in the River Frome, Dorset,
W85-04887 2H

AQUATIC WEEDS
Aquatic Macrophyte Vegetation of an Isolated Island Lake Adjacent to Lake Nipigon, Ontario: A Comparative Study After a Fifty-six Year Interval,
W85-04661 2H

AQUIFERS
Macroinvertebrates in a Sewage-Polluted Aquifer,
W85-04720 5C

ARCH DAMS
Medium and Small Masonry Arch Dams in China,
W85-04950 8A

ARGENTINA
Hydraulic Modelling at the Piedra del Aguila Dam,
W85-04781 8B

ARIZONA
Arizona Water Issues: Contrasting Economic and Legal Perspectives,
W85-04756 6E

Stewart Mountain Dam Concrete Core Analysis - 1983,
W85-04938 8A

ARSENIC
Arsenic Speciation in Soil-Pore Waters From Mineralized and Unmineralized Areas of South-West England,
W85-04662 2K

Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

ARTIFICIAL RECHARGE
Main Results of a Project for Artificial Groundwater Recharge from Secondarily Treated Sewage in the Municipal Forest of the City of Langen (Lower Main Region) (Die wichtigsten Ergebnisse eines Projektes zur kunstlichen Grundwasser-anreicherung mit weitergehend behandeltem Abwasser im Langener Stadtwald (Untermainregion)),
W85-04809 5D

ASPARTATE
Influence of Varying Environmental Conditions on the Activity of Heterotrophic Bacteria,
W85-04700 2H

ATCHAFALAYA RIVER BASIN
Effects of Soil Waterlogging on the Energy Status and Distribution of Salix nigra and S. exigua (Salicaceae) in the Atchafalaya River Basin of Louisiana,
W85-04943 2I

ATOMIC ABSORPTION SPECTROMETRY
Determination of Trace Amounts of Heavy Metals in Waters by a Flow-Injection System Including Ion-Exchange Preconcentration and Flame Atomic Absorption Spectrometric Detection,
W85-04653 5A

ATTENUATION
Migration and Attenuation of Selected Organics in a Sandy Aquifer - A Natural Gradient Experiment,
W85-04635 5B

ATTERSEE WATERSHED
Stream Phosphorus Exports from Prealpine Watersheds with Respect to Geology and Land Use,
W85-04560 5B

AUGUR HOLES
Hydraulic Conductivity Measured Electronically in an Auger Hole,
W85-04740 2G

AUSTRALIA
Groundwater Seepage and the Water Balance of a Closed, Freshwater, Coastal Dune Lake: Lake Windermere, Jervis Bay,
W85-04698 2F

Fluid Transport Processes in Upper Spencer Gulf,
W85-04762 2L

Physical Processes and Pollution in the Waters of Spencer Gulf,
W85-04763 2L

Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

AUSTRIA
Stream Phosphorus Exports from Prealpine Watersheds with Respect to Geology and Land Use,
W85-04560 5B

BACTERIA
Maintenance of Drinking Water Quality: The Essential Decisions,
W85-04449 5F

Studies on the Carbon Flux from Phyto- to Bacterioplankton Communities in Lake Constance,
W85-04672 2H

Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

Bacterial Colonization of Point-of-Use Water Treatment Devices,
W85-04834 5F

Sewage-Derived Bacteria Monitored in a Marine Water Column by Means of Captive Mussels,
W85-04868 5A

Seasonal Variations in Four Bacterial Size Fractions from a Hypertrophic Pond in Tokyo, Japan,
W85-04912 2H

BACTERIA ANALYSIS
Use of Bacteriological Indicators for Swimming Water Quality,
W85-04765 5A

BACTERIAL ANALYSIS
Determination of Microbial Cell Numbers in Subsurface Samples,
W85-04636 5A

BACTERIAL LEACHING
Commercial Mining Technique Offers a New Approach to Removing Heavy Metals from Sludges,
W85-04767 5D

BACTERIAL PHYSIOLGY
Effect of Some Heavy-metals on Glucose Assimilation in Polluted Waters,
W85-04705 5C

BACTERIAL PHYSIOLOGY
Influence of Varying Environmental Conditions on the Activity of Heterotrophic Bacteria,
W85-04700 2H

BAFFLED REACTORS
Performance Characteristics of the Anaerobic Baffled Reactor,
W85-04495 5D

BALDEGGERSEE
Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions),
W85-04559 5G

BALTIC SEA
Trace Metal and PCB Content of Mussels (Mytilus edulia) from the Southwestern Baltic Sea,
W85-04902 5B

BANGLADESH
Managment of Sedimentation in Bangladesh,
W85-04440 2J

Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

BASE CATIONS
Changes in Base Cation Concentrations Due to Freshwater Acidification,
W85-04532 5C

BASELINE STUDIES
Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

BASS
Confinement and Water Quality-Induced Stress in Largemouth Bass,
W85-04680 5C

Thermal Mortality Prediction Equations for Entrainable Striped Bass,
W85-04682 5C

BAYS
Fluid Transport Processes in Upper Spencer Gulf,
W85-04762 2L

BEAVERSKIN LAKE
Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

BEHAVIOR
Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

BELT FILTER PRESS
Drier Sludge Ends Landfill Leaching Concerns,
W85-04650 5D

BENTHIC FAUNA
Decline of Zoobenthos Through Five Decades of Eutrophication in Lake Esrom,
W85-04541 5C

BENTHOS
Preliminary Investigation on Effects of Fluctuating Flows on Invertebrates of the Hawea River, a Large Regulated River in New Zealand,
W85-04668 2H

Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

Predicting the Effect of Macrobenthos on the Sediment/Water Flux of Metals and Phosphorus,
W85-04839 2K

Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel,
W85-04863 5B

Benthic-Pelagic Coupling in Sewage-Affected Marine Ecosystems,
W85-04874 5C

BENZO (A)PYRENE
Simultaneous Accumulations of Naphthalene, a PCB Mixture, and Benzo(a)pyrene, by the Oyster, Crassostrea virginica,
W85-04477 5B

Simultaneous Exposure of English Sole (Parophrys vetulus) to Sediment-Associated Xenobiotics: Part 1 - Uptake and Disposition of 14C-Polychlorinated Biphenyls and 3H-Benzo(a)Pyrene,
W85-04870 5C

BERMUDA
Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

BHC
Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Frisian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland),
W85-04808 5B

BIOACCUMULATION
Simultaneous Accumulations of Naphthalene, a PCB Mixture, and Benzo(a)pyrene, by the Oyster, Crassostrea virginica,
W85-04477 5B

Short-Term Uptake of Heavy Metals by Periphyton Algae,
W85-04721 5B

Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

BIOASSAY
Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04898 5A

BIOCHEMICAL OXYGEN DEMAND
Decreasing Rate of Biochemical Oxidation of Sewage,
W85-04468 5D

BIODEGRADATION
Biodegradability of Two Primary Alcohol Ethoxylate Nonionic Surfactants Under Practical Conditions, and the Toxicity of the Biodegradation Products to Rainbow Trout,
W85-04487 5D

Biodegradation of Organic Chemicals,
W85-04797 5B

BIOINDICATORS
Determination of Polyaromatic Hydrocarbons in Scallops (Pecten maximus) by UV Fluorescence and HPLC Combined with UV and Fluorescence Detectors,
W85-04474 5B

Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

Radioecological Studies of Activation Products Released from a Nuclear Power Plant into the Marine Environment,
W85-04865 5B

BIOINDICATORS

Embryo Abnormalities in the Periwinkle, Littorina 'saxatilis', as Indicators of Stress in Polluted Marine Environments,
W85-04893 5A

BIOLOGICAL TREATMENT
Biological Denitrification in a Fluidized Bed,
W85-04660 5D

BIOLOGICAL WASTEWATER TREATMENT
A/O Process - Biological Treatment with Nutrient Removal,
W85-04594 5D

Commercial Mining Technique Offers a New Approach to Removing Heavy Metals from Sludges,
W85-04767 5D

Study of Domestic Sewage Waste Treatment by the Polychaetes, Neanthes japonica and Perinereis nuntia var. vallata, on an Artificial Tidal Flat,
W85-04903 5D

Nitrogenous Wastewater Treatment by Activated Algae,
W85-04967 5D

BIOMANIPULATION
Biomanipulation Experiment in Green Lake, Seattle, Washington,
W85-04671 5G

BIOMASS
Impact of Nutrient Load on Total Biomass and Species Succession in Lake Suwa, Japan,
W85-04565 5C

Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

Influence of Varying Environmental Conditions on the Activity of Heterotrophic Bacteria,
W85-04700 2H

Radiotracer Estimation of Microbial Biomass in Lake Sediment,
W85-04848 2H

Experimental Lake Fertilization in the Kuokkel Area, Northern Sweden. Phytoplankton Biomass and Algal Composition in Natural and Fertilized Subarctic Lakes,
W85-04910 2H

BIOTURBATION
Bioturbation and Microbial Activity,
W85-04704 2L

BOHAI BAY
Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

BOLIVIA
Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

BOMBAY HARBOR
Heavy Metals in the Bombay Harbour Area,
W85-04892 5C

BOTTOM SEDIMENTS
Phosphorus in the Bottom Sediments of Some Lakes of the World,
W85-04612 2H

BOWHOUSE WORKS
Bowhouse Sewerage and Sewage Disposal Scheme of Fife Regional Council,
W85-04508 5D

BRACHYCENTRUS
Biology of Brachycentrus subnubilus Curtis (Trichoptera) in the River Frome, Dorset,
W85-04887 2H

BRACKISH WATER
Brackish Groundwater as an Alternative Source of Cooling Water for Nuclear Power Plants in Israel,
W85-04599 4B

Brackish Water in Unsaturated Confining Beds at a Texas Lignite Mine,
W85-04639 2F

BRATSK RESERVOIR
Experience in Operating the Bratsk Reservoir,
W85-04429 4A

BRAZIL
Amazon Floodplain Lakes: Shape, Fetch, and Stratification,
W85-04568 2H

Vertical Mixing in Amazon Floodplain Lakes,
W85-04569 2H

Seasonal Variation of the Major Cation Content of the Varzea-Lake Lago Camaleao, Middle Amazon, Brazil, in 1981 and 1982,
W85-04570 2H

Nutrient Processing in Amazon Floodplain Lakes,
W85-04571 2K

Future of Hydropower in Brazil,
W85-04779 6B

Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

BREWERIES
Industrial Effluent Treatment at Sewage-Treatment Works: The Tadcaster Experience,
W85-04521 5D

BRIDGES
Consideration of Sediment Transport when Calculating Local Scour,
W85-04427 2J

BRINE SHRIMP
Effects of Four Heavy Metals on Survival and Hatching Rate of Artemia salina (L.),
W85-04674 5C

BRITISH COLUMBIA
Interflow Model: II. Model Validation,
W85-04579 2A

Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

Responses of Benthic Macroinvertebrate Species to Manipulation of Interstitial Detritus in Carnation Creek, British Columbia,
W85-04841 2H

Responses of Sockeye Salmon (Oncorhynchus nerka) to Fertilization of British Columbia Coastal Lakes,
W85-04847 8I

Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

BROOKS
Changes of Organic and Inorganic Nitrogen in a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Organische en Anorganische Stikstof van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04890 5G

BUTTLE LAKE
Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

CADDISFLIES
Biology of Brachycentrus subnubilus Curtis (Trichoptera) in the River Frome, Dorset,
W85-04887 2H

CADMIUM
In Vivo Effects of Cadmium on Some Enzyme Activities in Tissues of the Freshwater Catfish, Heteropneustes fossilis,
W85-04434 5C

CAISSONS
Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

CALCIUM
Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions,
W85-04498 5F

CALIBRATIONS
1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures,
W85-04928 7B

CALIFORNIA
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

Contrast in Stream-Channel Response to Major Storms in Two Mountainous Areas of California,
W85-04836 2J

Benthic-Pelagic Coupling in Sewage-Affected Marine Ecosystems,
W85-04874 5C

CAMPBELL RIVER ESTUARY
Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

CANADA
International Water Management in Canadian-American Relations, 1894-1907,
W85-04588 6E

Canadian Water Management: A One Armed Giant,
W85-04685 6A

Proposed Legal Framework for the Regulation of Drinking Water,
W85-04766 6E

Water Utility in the Nuclear Age,
W85-04773 5B

Water Use Reduction Through Metering Could Provide Significant Economic Benefits to Inuvik, N.W.T.,
W85-04919 3D

Water Conservation in the Northwest Territories - Public Education and Awareness Program,
W85-04920 3D

Acceptance of Treated Water by Northern Community Residents,
W85-04921 6D

Study of Water Bleeder Control Alternatives,
W85-04922 3D

Basic Technology of the Pulp and Paper Industry and Its Environmental Protection Practices,
W85-04932 5D

Chlorophenols and Their Impurities in the Canadian Environment: 1983 Supplement,
W85-04941 5B

CANAL
Controlling Erosion and Sedimentation in the Panama Canal Watershed,
W85-04442 4D

CANALS
Investigation of the Stability of River and Canal Channels,
W85-04422 2J

Discontinuous Wave on Stretches of an Abrupt Expansion of a Canal,
W85-04424 8B

CARBOHYDRATES
Distribution, Dynamic and Structure of Free Dissolved Carbohydrates in the Plusssee, a North German Eutrophic Lake,
W85-04552 2H

CARBON
Carbon Mineralization in Microaerobic and Anaerobic Strata of Lake Vechten (The Netherlands): Diffusion Flux Calculations and Sedimentation Measurements,
W85-04702 2H

CARBON DIOXIDE
Effects of Organic Pollutants on Methanogenesis, Sulfate Reduction and Carbon Dioxide Evolution in Salt Marsh Sediments,
W85-04872 5C

Blue-green Dominance in Lakes: The Role and Management Significance of pH and CO2,
W85-04909 2H

CARBON FLUX
Studies on the Carbon Flux from Phyto- to Bacterioplankton Communities in Lake Constance,
W85-04672 2H

CARBON RADIOISOTOPES
delta 13C Measurements as Indicators of Carbon Flow in Marine and Freshwater Ecosystems,
W85-04431 2K

Radiotracer Estimation of Microbial Biomass in Lake Sediment,
W85-04848 2H

CARBONATES
Distribution of Carbonates, Bicarbonates, and pH Values in Ground Water of the Nile Delta Region, Egypt,
W85-04638 2K

CARIBBEAN SEA
Radium Variability Produced by Shelf-water Transport and Mixing in the Western Gulf of Mexico,
W85-04712 2K

CARNATION CREEK
Responses of Benthic Macroinvertebrate Species to Manipulation of Interstitial Detritus in Carnation Creek, British Columbia,
W85-04841 2H

CATFISH
In Vivo Effects of Cadmium on Some Enzyme Activities in Tissues of the Freshwater Catfish, Heteropneustes fossilis,
W85-04434 5C

Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

CATHODIC STRIPPING VOLTAMMETRY
Determining Trace Concentrations of Copper in Water by Cathodic Film Stripping Voltammetry With Adsorptive Collection,
W85-04410 5A

CATIONS
Changes in Base Cation Concentrations Due to Freshwater Acidification,
W85-04532 5C

Seasonal Variation of the Major Cation Content of the Varzea-Lake Lago Camaleao, Middle Amazon, Brazil, in 1981 and 1982,
W85-04570 2H

CATTAILS
Detoxification of Effluents in a Macrophyte Treatment System,
W85-04489 5D

CEMENTS
Fly Ash and Fly Ash Concrete,
W85-04936 8F

CENTER PIVOT IRRIGATION
Integrated Water-Energy Management System for Center Pivot Irrigation: Functional Requirements,
W85-04742 7C

Integrated Water-Energy Management System for Center Pivot Irrigation: Implementation,
W85-04743 7C

CESIUM RADIOISOTOPES
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

CHALK AQUIFERS
Effects of the Recharge on Sewage Effluents Upon the Quality of Chalk Groundwater,
W85-04462 5C

CHANNEL EROSION
Kinematic Structure of Flow in a Trapezoidal Channel,
W85-04421 8B

Investigation of the Stability of River and Canal Channels,
W85-04422 2J

Computing Degradation and Local Scour,
W85-04934 2J

CHANNEL GEOMETRY
Contrast in Stream-Channel Response to Major Storms in Two Mountainous Areas of California,
W85-04836 2J

CHANNEL SCOUR
Investigation of the Stability of River and Canal Channels,
W85-04422 2J

Computing Degradation and Local Scour,
W85-04934 2J

CHANNELS
Investigation of the Stability of River and Canal Channels,
W85-04422 2J

CHEMICAL ANALYSIS
Importance of Speciation Methods in Analytical Control of Water Treatment Processes With Application to Fluoride Removal From Waste Waters,
W85-04485 5A

Estimation of Sulphate Ions in Water and Industrial Wastes Using a Solid State Membrane Electrode,
W85-04488 7B

Determination of Trialkyl and Triaryl Phosphates in Environmental Samples,
W85-04497 5B

CHEMICAL COAGULATION
Chemical Flocculation for Suspended Solids Removal at Remote Mine Sites,
W85-04730 5D

CHEMICAL COMPOSITION
Small-scale Temporal Changes in the Biological and Chemical Composition of Surface Microlayers in a Eutrophic Lake,
W85-04538 2H

Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

Composition and Possible Origin of Detrital Material in Streams,
W85-04827 2J

CHEMICAL CRYSTALLIZATION
Some Characteristics of Chemical Crystallization in Water Purification Process,
W85-04409 5F

CHEMICAL OXYGEN DEMAND
Determination of COD by a Mercury-Free Open-Tube Method,
W85-04467 5A

Quantitative Estimation in COD Units of Refractory Organic Compounds Produced by Activated Sludge Microorganisms,
W85-04486 5D

CHEMICAL PRECIPITATION
Some Characteristics of Chemical Crystallization in Water Purification Process,
W85-04409 5F

CHEMICAL PROPERTIES
Multistage Model for the Development of Hydrochemical Zonation in Chalk Ground Waters,
W85-04634 2K

Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes,
W85-04789 5C

Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry,
W85-04792 5C

Chemical Survey of the Volta Estuary,
W85-04854 2L

CHEMICALS WASTES
Decomissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

CHILE
Economic/Institutional Issues in Sedimentation Management in Developing Countries,
W85-04443 4D

CHINA
Sedimentation Problem in Water Conservancy in China,
W85-04446 4D

CHINA (PEOPLES REPUBLIC)
Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

Small Hydro in China: Progress and Prospects,
W85-04947 6B

Exploiting Seasonal Energy from Small Hydropower Stations,
W85-04948 6B

Role of Small Hydro in Rural Electrification,
W85-04949 6B

Medium and Small Masonry Arch Dams in China,
W85-04950 8A

Large Hydropower Stations in China,
W85-04951 6B

CHLORINATED HYDROCARBONS
Organochlorine Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04437 5B

PCBs, DDTs and Other Chlorinated Hydrocarbons in Marine Organisms from the Mediterranean Coast of Israel,
W85-04894 5B

CHLORINATED ORGANIC PESTICIDES
PCBs and Organochlorine Pesticides in the St. Lawrence System (BPC ET Pesticides Organochlores Dans Le Systeme Saint-Laurent),
W85-04581 5B

CHLORINATED PHENOLS
Ecoepidemiology - A Casuistic Discipline Describing Ecological Disturbances and Damages in Relation to Their Specific Causes: Exemplified by Chlorinated Phenols and Chlorophenoxy Acids,
W85-04777 5C

Influence of pH and Ionic Strength on the Aqueous-Nonaqueous Distribution of Chlorinated Phenols,
W85-04803 5B

CHLORINE
Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

CHLOROPHENOLS
Chlorophenols and Their Impurities in the Canadian Environment: 1983 Supplement,
W85-04941 5B

CHLOROPHENOXY ACIDS
Ecoepidemiology - A Casuistic Discipline Describing Ecological Disturbances and Damages in Relation to Their Specific Causes: Exemplified by Chlorinated Phenols and Chlorophenoxy Acids,
W85-04777 5C

CHLOROPHYTA
Blue-green Dominance in Lakes: The Role and Management Significance of pH and CO2,
W85-04909 2H

CHROMATES
Simultaneous Determination of Zinc and Chromate in Cooling Water by Differential Pulse Polarography,
W85-04624 5A

CHROMATOGRAPHY
Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

CHROMIUM
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

Effect of Effluent High in Chromium on Marine Sediment Aerobic Heterotrophic Bacteria,
W85-04869 5C

CIENAGA GRANDE
Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance,
W85-04907 2L

CLAMS
Bioturbation and Microbial Activity,
W85-04704 2L

CLIFTON SPRINGS
Nitrate Contamination: Public Awareness,
W85-04828 5F

COAGULATION
Influence of the Charge Density of Cationic Polyelectrolytes on Sludge Conditioning,
W85-04494 5D

Removal of New Indicators by Coagulation and Filtration,
W85-04833 5F

COAL GASIFICATION
Gasifier Wastewater Treatment: Phase I Cooling Tower Assessment,
W85-04879 5D

COAL LIQUIFACTION
Fate of Contaminants During Treatment of H-Coal Process Wastewaters,
W85-04878 5D

COAL MINES
Treatment of Ferruginous Ground Water from an Abandoned Colliery,
W85-04596 5D

Attenuation of Chemical Elements in Acidic Leachates from Coal Mineral Wastes by Soils,
W85-04600 5B

COASTAL MARSHES
Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

COASTAL WATERS
Bioturbation and Microbial Activity,
W85-04704 2L

Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 1. Environmental Conditions,
W85-04710 5C

Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 2. Nutrient Salts,
W85-04711 5C

Radium Variability Produced by Shelf-water Transport and Mixing in the Western Gulf of Mexico,
W85-04712 2K

COBALT RADIOISOTOPES
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

COLD DIGESTION
Accelerated Cold Digestion: A New Look at an Old Technique,
W85-04591 5D

COLD REGIONS
Status of Sanitation Facilities in Alaska - 1982,
W85-04915 6B

Utilities Delivery for the Indian and Inuit Affairs Program,
W85-04916 6B

COLIPHAGES
T2-Coliphage Uptake By Mosquito Larvae,
W85-04493 5D

COLOMBIA
Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance,
W85-04907 2L

COLORADO
Effects of Electricity Rates and Rate Structures on Pump Irrigation: An Eastern Colorado Case Study,
W85-04752 3F

Causes of a Waterborne Giardiasis Outbreak,
W85-04830 5F

Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

COLORIMETRY
Evaluation of Acidification Based on Former Colorimetric Determination of pH: The Effect of Indicators on pH in Poorly Buffered Water,
W85-04530 5A

COMBINED SEWER OVERFLOWS
Linear Programming Model for the Control of Combined Sewer Systems with Off-Line Storage Facilities,
W85-04576 5G

Flow Balancing System for Stormwater and Combined Sewer Overflow,
W85-04772 5D

COMPLEXATION
Adsorption and Complexation Mechanisms of Heavy Metal Uptake in Activated Sludge,
W85-04411 5D

Measurement of Particulate Association of Americium in Freshwater,
W85-04491 5A

COMPRESSIVE STRENGTH
Parker Dam Concrete Core Investigations,
W85-04935 8F

Stewart Mountain Dam Concrete Core Analysis - 1983,
W85-04938 8A

COMPUTER MODELS
Linear Programming Model for the Control of Combined Sewer Systems with Off-Line Storage Facilities,
W85-04576 5G

COMPUTER PROGRAMS
Galerkin Finite-Element Program for Simulating Unsaturated Flow in Porous Media,
W85-04645 2F

COMPUTER SIMULATION
Simulated Effects of Fertilizer Management on Nitrate Loss with Tile Drainage Water for Continuous Corn,
W85-04739 6G

COMPUTERS
BASIC Program for the Investigation of Species Diversity,
W85-04513 7C

Doing a Job on Data,
W85-04651 7C

Integrated Water-Energy Management System for Center Pivot Irrigation: Functional Requirements,
W85-04742 7C

Integrated Water-Energy Management System for Center Pivot Irrigation: Implementation,
W85-04743 7C

CONCRETE ADDITIVES
Fly Ash and Fly Ash Concrete,
W85-04936 8F

CONCRETE DAMS
Parker Dam Concrete Core Investigations,
W85-04935 8F

Stewart Mountain Dam Concrete Core Analysis - 1983,
W85-04938 8A

CONCRETE MIXES
Fly Ash and Fly Ash Concrete,
W85-04936 8F

CONCRETE TECHNOLOGY
Fly Ash and Fly Ash Concrete,
W85-04936 8F

CONCRETES
Long-Term Prestress in Concrete-Lined Pressure Tunnels,
W85-04414 8F

Determination of Certain Rheological Characteristics of Concrete Mixes by Shear Testing,
W85-04425 8F

Fly Ash and Fly Ash Concrete,
W85-04936 8F

CONFINING BEDS
Brackish Water in Unsaturated Confining Beds at a Texas Lignite Mine,
W85-04639 2F

CONSERVATION TILLAGE
Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

CONSTRUCTION
Developments in Materials and Design Techniques for Sewerage Systems,
W85-04517 8A

CONSTRUCTION METHODS
High-Head Spillway with Swirling of the Flow in the Outlet Section,
W85-04420 8A

CONTINUOUS CROPPING
Simulated Effects of Fertilizer Management on Nitrate Loss with Tile Drainage Water for Continuous Corn,
W85-04739 6G

CONTRA SHEAR
Screening: A New Approach,
W85-04523 5D

CONTROL SYSTEMS
Study of Water Bleeder Control Alternatives,
W85-04922 3D

COOLING WATER
Enhance Cooling-Water Reuse with Sidestream Softening,
W85-04469 5F

Brackish Groundwater as an Alternative Source of Cooling Water for Nuclear Power Plants in Israel,
W85-04599 4B

Simultaneous Determination of Zinc and Chromate in Cooling Water by Differential Pulse Polarography,
W85-04624 5A

Control of Suspended Solids in Open Cooling Water Systems,
W85-04820 5F

Gasifier Wastewater Treatment: Phase I Cooling Tower Assessment,
W85-04879 5D

COPEPODS
Toxicity of Effluents from a TiO2 Plant to the Harpacticoid Copepod Nitocra spinipes Boeck,
W85-04866 5C

COPPER
Determining Trace Concentrations of Copper in Water by Cathodic Film Stripping Voltammetry With Adsorptive Collection,
W85-04410 5A

Copper Complexation and Toxicity to Daphnia in Natural Waters,
W85-04716 5C

Effect of Ionic Interactions on the Oxidation of Metals in Natural Waters,
W85-04761 2K

Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

Acute Toxicity of Copper to Three Life Stages of Chrionomus tentans as Affected by Water Hardness-Alkalinity,
W85-04946 5C

COPROSTANOL
Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Frisian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland),
W85-04808 5B

CORN
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

CORPUS CHRISTI
Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas,
W85-04480 5B

CORPUS CHRISTI BAY
Phytoplankton Production in the Corpus Christi Bay Estuary,
W85-04432 2L

CORROSIVITY
Acid Rain: Dousing Community Resources,
W85-04750 5F

COST ANALYSIS
Cost-Effective Management - Revenue and Technical Monitoring,
W85-04519 6B

Economic Analysis of Water and Sanitation Alternatives for Communities in Northern Canada,
W85-04917 6A

Control and Treatment Technology for the Metal Finishing Industry. In-Plant Changes.
W85-04929 5D

Control and Treatment Technology for the Metal Finishing Industry. Ion Exchange.
W85-04931 5D

Recovery of Spent Sulfuric Acid from Steel Pickling Operations.
W85-04933 5E

COST-BENEFIT ANALYSIS
Acid Deposition Control, A Benefit-Cost Analysis: Its Prospects and Limits,
W85-04798 6B

COST SHARING
Cost Sharing in a Multipurpose Water Project,
W85-04778 6C

COSTA RICA
Throughfall and Stem Flow in Mature and Year-Old Wet Tropical Forest,
W85-04853 2I

COSTS
Practical Aspects of Energy Saving in Wastewater Disposal,
W85-04595 5D

Retrofitting Apartment Buildings To Reduce Costs and Water Demand,
W85-04690 3D

COYOTE GULCH
Sediment Storage and Terrace Formation in Coyote Gulch Basin, South-Central Utah,
W85-04646 2J

CRABS
Trace Metal-Binding Proteins in Marine Molluscs and Crustaceans,
W85-04873 5C

CREDIT RIVER WATERSHED
Floodplain Policy and Practice in the Credit River Watershed, Ontario,
W85-04587 6F

CREEP
Long-Term Prestress in Concrete-Lined Pressure Tunnels,
W85-04414 8F

CRETACEOUS CHALK AQUIFER
Multistage Model for the Development of Hydrochemical Zonation in Chalk Ground Waters,
W85-04634 2K

CROCODILE RIVER
Diatoms of the Jukskei-Crocodile River System (Transvaal, Republic of South Africa): A Preliminary Check-List,
W85-04814 2H

CROP CANOPIES
Prediction of Soil Erosion by Water and Wind for Various Fractions of Cover,
W85-04732 2J

CROP YIELD
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

CROP YIELDS
Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
W85-04727 2D

CRYSTALLIZATION
Some Characteristics of Chemical Crystallization in Water Purification Process,
W85-04409 5F

CULTIVATION
Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

CURRENTS
Physical Processes and Pollution in the Waters of Spencer Gulf,
W85-04763 2L

CYANIDES
Oxidation of Cyanides in Industrial Wastewaters by Ozone,
W85-04881 5D

CYANOPHYTA
Blue-green Dominance in Lakes: The Role and Management Significance of pH and CO2,
W85-04909 2H

CYCLING NUTRIENTS
Oyster Reefs as Processors of Estuarine Materials,
W85-04483 2L

Studies on the Carbon Flux from Phyto- to Bacterioplankton Communities in Lake Constance,
W85-04672 2H

Measurement and Comparative Values of the Short Circuit Metabolism (SCM) of Lakes by POC Relationship of Primary Production of Phytoplankton and Settling Matter,
W85-04701 2H

Carbon Mineralization in Microaerobic and Anaerobic Strata of Lake Vechten (The Netherlands): Diffusion Flux Calculations and Sedimentation Measurements,
W85-04702 2H

Phosphorus, Nitrogen, and Carbon Cycling by Fish Populations in Two Small Lowland Rivers in Poland,
W85-04888 5B

Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

DAL LAKE
Sediment Composition, Mud-water Interchanges and the Role of Macrophytes in Dal Lake, Kashmir,
W85-04904 2H

DAM-BREAK WAVES
Simplest Approximate Computation of Dam-break Waves (Die Einfachste Naherungsberechnung von Dammbruchwellen),
W85-04630 8B

DAM CONSTRUCTION
Low-Head Hydropower for Local Use,
W85-04620 6B

Uribante-Doradas Hydro Development in Venezuela,
W85-04783 8A

Medium and Small Masonry Arch Dams in China,
W85-04950 8A

DAM EFFECTS
Environmental Management Planning for Dams and Hydro Schemes.
W85-04784 6G

DAM FAILURE
Risk of Damage and Failure of Earth Dams,
W85-04430 8D

Simplest Approximate Computation of Dam-break Waves (Die Einfachste Naherungsberechnung von Dammbruchwellen),
W85-04630 8B

DAM STABILITY
Closed Formulae for Earthquake-Induced Deformations in Dams,
W85-04782 8D

DAMS
Masinga Dam in Kenya,
W85-04471 8A

DAPHNIA
Copper Complexation and Toxicity to Daphnia in Natural Waters,
W85-04716 5C

DATA ACQUISITION
Measurement of the Performance of Sewerage Systems and Associated Hydraulic Structures - Recent Developments,
W85-04511 5D

Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

DATA COLLECTIONS
Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

DATA PROCESSING
BASIC Program for the Investigation of Species Diversity,
W85-04513 7C

Doing a Job on Data,
W85-04651 7C

DEBRIS
Relationships Between Woody Debris and Fish Habitat in a Small Warmwater Stream,
W85-04679 2E

DECHLORINATION
Effects of Dechlorinated Seawater on Fish Behavior,
W85-04862 5D

DECISION MAKING
Methodology for Pollution Control Decision Analysis,
W85-04582 5G

DECOMPOSING ORGANIC MATTER
Comparison of Leaching Losses from Decomposing Litter of the Terrestrial and Marsh Plants on Land and in Water,
W85-04553 2L

DECOMPOSITION
Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance,
W85-04907 2L

DEEP SHAFT TREATMENT
Pilot-Plant Evaluation of a Deep Shaft Linked to Conventional Aeration Without Inter-Stage Settlement to Give a Fully-Nitrified Effluent,
W85-04452 5D

DEFORMATION
Closed Formulae for Earthquake-Induced Deformations in Dams,
W85-04782 8D

DEICERS
Factors Influencing the Behaviour of De-Icing Salts in an Urban Flood Control Reservoir,
W85-04584 5B

DEIGHTON
Resurrection of Deighton Sewage Treatment Works,
W85-04512 5D

DELAWARE
Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

DENITRIFICATION
Optimization of Coleshill Activated-Sludge Plant Operating Conditions,
W85-04390 5D

Biological Denitrification in a Fluidized Bed,
W85-04660 5D

DENMARK
Dissolved Organic Carbon in Danish Lakes: Concentration, Composition, and Lability,
W85-04540 5C

Decline of Zoobenthos Through Five Decades of Eutrophication in Lake Esrom,
W85-04541 5C

Ecoepidemiology - A Casuistic Discipline Describing Ecological Disturbances and Damages in Relation to Their Specific Causes: Exemplified by Chlorinated Phenols and Chlorophenoxy Acids,
W85-04777 5C

DEOXYRIBONUCLEIC ACID
Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

DESIGN CRITERIA
Economizing the Diameter of Tunnels,
W85-04413 8A

Consideration of Sediment Transport when Calculating Local Scour,
W85-04427 2J

Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

Masinga Dam in Kenya,
W85-04471 8A

Developments in Materials and Design Techniques for Sewerage Systems,
W85-04517 8A

Malawi - Driving a 9 m Diameter Power Conduit with Low Cover at Nkula Falls,
W85-04819 8A

Operation and Maintenance Considerations for the Design of Arctic Water Systems,
W85-04923 6A

DESIGN STANDARDS
Operation and Maintenance Considerations for the Design of Arctic Water Systems,
W85-04923 6A

DESORPTION
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

DESTRATIFICATION
Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions),
W85-04559 5G

DETENTION RESERVOIRS
Residence Time in Stormwater Detention Basins,
W85-04968 5D

DETRITUS
Composition and Possible Origin of Detrital Material in Streams,
W85-04827 2J

Responses of Benthic Macroinvertebrate Species to Manipulation of Interstitial Detritus in Carnation Creek, British Columbia,
W85-04841 2H

DEVELOPING COUNTRIES
Economic/Institutional Issues in Sedimentation Management in Developing Countries,
W85-04443 4D

Private and Social Cost - Benefit Perspectives and a Case Application on Reservoir Sedimentation Management,
W85-04447 4D

DIALYSIS
Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

DIATOMS
Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

Diatoms of the Jukskei-Crocodile River System (Transvaal, Republic of South Africa): A Preliminary Check-List,
W85-04814 2H

Model of Diatom Dynamics in the Epilimnion of Lake Jezero on the Island of Krk,
W85-04900 2H

Effects of Ecological Perturbations on Diatom Dynamics in the Model of Lake Jezero,
W85-04901 2H

DICHLOBENIL
Aquatic Toxicity of 2,6-Dichlorobenzamide (BAM), a Degradation Product of the Herbicide Dichlobenil,
W85-04944 5C

DICHLOROBENZAMIDE
Aquatic Toxicity of 2,6-Dichlorobenzamide (BAM), a Degradation Product of the Herbicide Dichlobenil,
W85-04944 5C

DIFFERENTIAL EQUATIONS
Fundamental Differential Equation of Flow of a Fluid with a Variable Mass in the Case of Bilateral Water Diversion,
W85-04428 2E

DISCONTINUOUS WAVES
Discontinuous Wave on Stretches of an Abrupt Expansion of a Canal,
W85-04424 8B

DISCRIMINANT ANALYSIS
Prediction of Red Tide Occurrence by Means of Discriminant Analysis (in Japanese),
W85-04605 5C

DISINFECTANTS
Destruction of Pathogens and Parasites in Sewage Sludge by Chemical Means,
W85-04592 5E

DISINFECTION
Giardia Lamblia and Water Supply,
W85-04829 5F

DISPERSANTS
Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

DISPERSION
Dispersion Modeling of Multiple Sources Using the HP-41CV,
W85-04644 5B

Dispersion Model for Waste Stabilization Ponds,
W85-04966 5D

DISSOLVED OXYGEN
Note on the Prediction of Dissolved Oxygen Concentration in Estuaries,
W85-04529 2L

Sensitivity Analysis of Reservoir Oxygen Model,
W85-04585 2H

Inorganic Nutrients Occurring in the Oxygen-deficient Bottom Water of Osaka Bay,
W85-04606 2K

Lake Ontario Oxygen Model. 1. Model Development and Application,
W85-04801 2H

Lake Ontario Oxygen Model. 2. Errors Associated with Estimating Transport Across the Thermocline,
W85-04802 2H

DISSOLVED SOLIDS
Dissolved Organic Carbon in Danish Lakes: Concentration, Composition, and Lability,
W85-04540 5C

Effects of Dissolved Organic Carbon on the Adsorption Properties of Plutonium in Natural Waters,
W85-04799 5B

Voltammetric Methods for Distinguishing between Dissolved and Particulate Metal Ion Concentrations in the Presence of Hydrous Oxides. A Case Study on Lead (II),
W85-04800 5A

Water Quality of the Colorado River System: Historical Trends in Concentration Load, and Mass Fraction of Inorganic Solutes,
W85-04942 2E

DISTRIBUTION
Estimating the Parameters of a Cube Root Normal Distribution from Reduced Sample Data,
W85-04796 2B

DIURNAL VARIATION
Diurnal Cycle of Stratification in Lake Titicaca: Eddy Diffusion,
W85-04567 2H

Primary Production and Diuranal Variation in a Tropical Fish Pond,
W85-04852 5C

DIVERSION
Fundamental Differential Equation of Flow of a Fluid with a Variable Mass in the Case of Bilateral Water Diversion,
W85-04428 2E

DOMESTIC WATER
Retrofitting Apartment Buildings To Reduce Costs and Water Demand,
W85-04690 3D

DRAGONFLIES
Effects of Trichloroacetic Acid, a New Contaminant Found from Chlorinating Water with Organic Material, on Dragonfly Nymphs,
W85-04478 5C

DRAIN TUBES
Effect of Drain Tube Openings on Drainage and Subirrigation,
W85-04748 4A

DRAINAGE
Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

Simulated Effects of Fertilizer Management on Nitrate Loss with Tile Drainage Water for Continuous Corn,
W85-04739 6G

Effect of Drain Tube Openings on Drainage and Subirrigation,
W85-04748 4A

DRAINAGE EFFECTS
Effects of Land Drainage on Stream Flow,
W85-04583 4C

DRAWDOWN
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

DREDGING
Sediment Budget Study of Clamshell Dredging and Ocean Disposal Activities in the New York Bight,
W85-04598 6G

DRIFT
Quantification of Stream Drift,
W85-04842 2H

DRINKING WATER
Maintenance of Drinking Water Quality: The Essential Decisions,
W85-04449 5F

Waterborne Outbreak of Hepatitis A in Meade County, Kentucky,
W85-04658 5C

Proposed Legal Framework for the Regulation of Drinking Water,
W85-04766 6E

Nitrate Contamination: Public Awareness,
W85-04828 5F

Causes of a Waterborne Giardiasis Outbreak,
W85-04830 5F

Removing Giardia Cysts with Slow Sand Filtration,
W85-04831 5F

Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

Bacterial Colonization of Point-of-Use Water Treatment Devices,
W85-04834 5F

DRIP IRRIGATION
Stomatal Responses to Leaf Water Potentials of Drip Irrigated Peach (Prunus persica),
W85-04746 2I

EARTH DAMS
Risk of Damage and Failure of Earth Dams,
W85-04430 8D

EARTHQUAKES
Closed Formulae for Earthquake-Induced Deformations in Dams,
W85-04782 8D

EAST ANGLIA
Evaluation of Eutrophication Impact in Public Water Supply Reservoirs in East Anglia,
W85-04451 5C

ECHO LAKE
Assessment of Historical Change in Two Northern Minnesota Lakes,
W85-04602 5B

ECOEPIDEMIOLOGY
Ecoepidemiology - A Casuistic Discipline Describing Ecological Disturbances and Damages in Relation to Their Specific Causes: Exemplified by Chlorinated Phenols and Chlorophenoxy Acids,
W85-04777 5C

ECOLOGICAL DISTRIBUTION
Possible Relationships Between Surface Water Chemistry and Aquatic Plants in the Northern Great Plains,
W85-04697 2H

ECOLOGICAL EFFECTS
Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

ECOLOGY
Recent Changes in the Ecology of Lake Naivasha, Kenya,
W85-04566 2H

Influence of Varying Environmental Conditions on the Activity of Heterotrophic Bacteria,
W85-04700 2H

ECONOMIC ASPECTS
Economizing the Diameter of Tunnels,
W85-04413 8A

Economic/Institutional Issues in Sedimentation Management in Developing Countries,
W85-04443 4D

Problems Associated with the Disposal of Trade Effluent to Sewers - Charging and Control,
W85-04463 5E

Proposed Framework for Developing a Multidisciplinary Wetlands Valuation Model,
W85-04684 2L

Canadian Water Management: A One Armed Giant,
W85-04685 6A

Role of Pricing in Managing the Demand for Water,
W85-04686 6A

Peak Use Charge: An Equitable Approach to Charging for and/or Reducing Summer Peak Use,
W85-04687 6C

Empirical Basis for Municipal Water Rates Modification,
W85-04688 3D

Environmental Control and Regional Growth,
W85-04755 6G

Arizona Water Issues: Contrasting Economic and Legal Perspectives,
W85-04756 6E

Economic Analysis of Water and Sanitation Alternatives for Communities in Northern Canada,
W85-04917 6A

Privatization Needs the Professional Approach,
W85-04954 6A

ECONOMIC FACTORS
Effects of Electricity Rates and Rate Structures on Pump Irrigation: An Eastern Colorado Case Study,
W85-04752 3F

ECOSYSTEMS
delta 13C Measurements as Indicators of Carbon Flow in Marine and Freshwater Ecosystems,
W85-04431 2K

Assessment of Historical Change in Two Northern Minnesota Lakes,
W85-04602 5B

Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

Physical Model of the Aquatic Ecosystem,
W85-04850 2H

ECOTOXICOLOGY
Chlorophenols and Their Impurities in the Canadian Environment: 1983 Supplement,
W85-04941 5B

ECUADOR
Integrated Planning System for Hydro Development in Ecuador,
W85-04780 6A

EDDY DIFFUSION
Diurnal Cycle of Stratification in Lake Titicaca: Eddy Diffusion,
W85-04567 2H

EDGECOMBE COUNTY
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

EDTA
Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

EFFLUENTS
Effects of the Recharge on Sewage Effluents Upon the Quality of Chalk Groundwater,
W85-04462 5C

Main Results of a Project for Artificial Ground-Water Recharge from Secondarily Treated Sewage in the Municipal Forest of the City of Langen (Lower Main Region) (Die wichtigsten Ergebnisse eines Projektes zur kunstlichen Grundwasser-anreicherung mit weitergehend behandeltem Abwasser im Langener Stadtwald (Untermainregion)),
W85-04809 5D

Decomissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

EGYPT
Distribution of Carbonates, Bicarbonates, and pH Values in Ground Water of the Nile Delta Region, Egypt,
W85-04638 2K

ELECTRIC POWER GENERATION
Convert the Brook on Your Farm to Electric Current,
W85-04813 8C

ELECTRODES
Estimation of Sulphate Ions in Water and Industrial Wastes Using a Solid State Membrane Electrode,
W85-04488 7B

ELECTRONIC EQUIPMENT
1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures,
W85-04928 7B

ELEMENTAL COMPOSITION
Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

ELODEA
Quiescence, Growth and Senescence of Egeria densa in Lake Marion,
W85-04858 2H

EMS-DOLLART ESTUARY
Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

ENERGY
Practical Aspects of Energy Saving in Wastewater Disposal,
W85-04595 5D

ENERGY CONSERVATION
Sewage Plant Provides Energy for District Heating System,
W85-04770 5D

ENERGY MANAGEMENT
Integrated Water-Energy Management System for Center Pivot Irrigation: Functional Requirements,
W85-04742 7C

Integrated Water-Energy Management System for Center Pivot Irrigation: Implementation,
W85-04743 7C

ENGLAND
Development and Use of a Theoretical Mathematical Model for the Medway Estuary,
W85-04450 2L

Evaluation of Eutrophication Impact in Public Water Supply Reservoirs in East Anglia,
W85-04451 5C

Pollution Control in the Humber Estuary,
W85-04453 5G

Monitoring of River Water Quality within the Great Ouse Basin Using the Chironomid Exuvial Analysis Technique,
W85-04454 5A

Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

Water Reclamation and River Management in the Tame Basin,
W85-04460 5G

Effects of the Recharge on Sewage Effluents Upon the Quality of Chalk Groundwater,
W85-04462 5C

Large-Scale Field Experiment in the Control of Eutrophication in the Norfolk Broads,
W85-04465 5G

Rainborne SO2, Precipitation pH and Airborne SO2 Over Short Sampling Times Throughout Individual Events,
W85-04500 5B

Biological Considerations in the Setting of Quality Standards for the Tidal Thames,
W85-04509 5G

Resurrection of Deighton Sewage Treatment Works,
W85-04512 5D

Industrial Effluent Treatment at Sewage-Treatment Works: The Tadcaster Experience,
W85-04521 5D

Pollution Control Policies for the Tees Estuary,
W85-04525 5G

Nutrient Removal Trials and Bioassay Evaluation at Budds Farm Sewage-Treatment Works, Havant,
W85-04526 5D

Pollution Management and the Tidal Thames,
W85-04527 5G

Multistage Model for the Development of Hydrochemical Zonation in Chalk Ground Waters,
W85-04634 2K

Arsenic Speciation in Soil-Pore Waters From Mineralized and Unmineralized Areas of South-West England,
W85-04662 2K

Solving the Problem of Rehabilitating Decayed Sewer Systems,
W85-04768 8A

Biology of Brachycentrus subnubilus Curtis (Trichoptera) in the River Frome, Dorset,
W85-04887 2H

ENVIRONMENTAL CONTROL
Environmental Control and Regional Growth,
W85-04755 6G

ENVIRONMENTAL EFFECTS
Potential Effects on Ground Water of a Hypothetical Surface Coal Mine in Indiana,
W85-04418 4C

Pollution Management and the Tidal Thames,
W85-04527 5G

Outdoor Recreation - A New Factor Disturbing Lake Ecosystems, as Exemplified by Lake Gim, Mazurian Lake District,
W85-04557 5C

Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

Opportunity Costs of Preserving Coastal Wetlands: A Case Study of a Recreational Housing Development,
W85-04754 6B

Environmental Management Planning for Dams and Hydro Schemes.
W85-04784 6G

Chlorophenols and Their Impurities in the Canadian Environment: 1983 Supplement,
W85-04941 5B

ENVIRONMENTAL PROTECTION
Groundwater Quality Protection: The Issue in Perspective,
W85-04683 5G

ENZYMES
In Vivo Effects of Cadmium on Some Enzyme Activities in Tissues of the Freshwater Catfish, Heteropneustes fossilis,
W85-04434 5C

EPICHOLESTANOL
5-alpha(H)-Cholestan-3-alpha-ol in Sediments: Characterization and Geochemical Significance,
W85-04759 2K

EPIPELON
Seston-Epipelon Interrelationships in the Shallow Eutrophic Loosdrecht Lakes (The Netherlands),
W85-04547 2H

ERODIBILITY
Rangeland Erosion Measurements for the USLE,
W85-04728 2J

EROSION
Kinematic Structure of Flow in a Trapezoidal Channel,
W85-04421 8B

Watershed Rehabilitation Program Related to the Management of River and Reservoir Sedimentation in Indonesia,
W85-04438 4D

Reservoir Sedimentation in India – Its Causes, Control, and Future Course of Action,
W85-04439 6G

Rangeland Erosion Measurements for the USLE,
W85-04728 2J

Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

EROSION CONTROL
Sedimentation Problem in Water Conservancy in China,
W85-04446 4D

ERROR ANALYSIS
Measurements and Estimation in Hydrology - Ideas and Proposals for the Quantification of Errors and Uncertainties (Messungen und Schatzungen in der Hydrologie - Gedanken und Vorschlage zur Quantifizierung der Fehler und Unsicherheiten),
W85-04805 7B

ERRORS
Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

ESTIMATING
Estimating the Parameters of a Cube Root Normal Distribution from Reduced Sample Data,
W85-04796 2B

ESTIMATION
Method for Estimating Precipitation Amounts at Remote Field Sites,
W85-04667 2B

Measurements and Estimation in Hydrology - Ideas and Proposals for the Quantification of Errors and Uncertainties (Messungen und Schatzungen in der Hydrologie - Gedanken und Vorschlage zur Quantifizierung der Fehler und Unsicherheiten),
W85-04805 7B

ESTUARIES
Development and Use of a Theoretical Mathematical Model for the Medway Estuary,
W85-04450 2L

Note on the Prediction of Dissolved Oxygen Concentration in Estuaries,
W85-04529 2L

Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

ESTUARINE ENVIRONMENT
Phytoplankton Production in the Corpus Christi Bay Estuary,
W85-04432 2L

Oyster Reefs as Processors of Estuarine Materials,
W85-04483 2L

Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

Method to Measure Suspended Load Transports in Estuaries,
W85-04675 2L

Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

ESTUARINES
Evaluation of a Moving-Co-ordinate System Model of Salinity Intrusion into the Mersey Estuary,
W85-04528 2L

EUPHOTIC ZONE
Impact of Sedimentation on the Phosphorus Content of the Euphotic Zone of Lake Constance,
W85-04555 2H

EUTROPHIC LAKES
Small-scale Temporal Changes in the Biological and Chemical Composition of Surface Microlayers in a Eutrophic Lake,
W85-04538 2H

Distribution, Dynamic and Structure of Free Dissolved Carbohydrates in the Plussee, a North German Eutrophic Lake,
W85-04552 2H

Methanogenesis in Sediments of Eutrophic Lakes; 2. Comparative Investigations on the Methane-Precursor Preference,
W85-04554 2H

Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions),
W85-04559 5G

EUTROPHICATION
Evaluation of Eutrophication Impact in Public Water Supply Reservoirs in East Anglia,
W85-04451 5C

Large-Scale Field Experiment in the Control of Eutrophication in the Norfolk Broads,
W85-04465 5G

Decline of Zoobenthos Through Five Decades of Eutrophication in Lake Esrom,
W85-04541 5C

Macrophytes in the Loosdrecht Lakes: A Story of Their Decline in the Course of Eutrophication,
W85-04549 5C

Modelling Eutrophication in Shallow Dutch Lakes,
W85-04551 5C

Eutrophication of Lake Balaton: Measurements, Modeling and Management,
W85-04562 5C

Eutrophication Control and the Fallacy of Nitrogen Removal,
W85-04774 5G

Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04898 5A

EVALUATION
Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality,
W85-04753 6B

Role of Small Hydro in Rural Electrification,
W85-04949 6B

EVAPOTRANSPIRATION
Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
W85-04727 2D

EXCAVATION
Prediction and Control of Ground Movement Associated with Trench Excavation,
W85-04516 8D

EXPLOSIONS
Underwater Piercing of a Tunnel,
W85-04415 8A

EXTRACTION
Dithiocarbamate Extraction of Gallium from Natural Waters and from Biological Samples for Neutron Activation Analysis,
W85-04961 5A

FAIRFAX COUNTY
Peak Use Charge: An Equitable Approach to Charging for and/or Reducing Summer Peak Use,
W85-04687 6C

FALLOUT
Water Utility in the Nuclear Age,
W85-04773 5B

FARMS
Convert the Brook on Your Farm to Electric Current,
W85-04813 8C

FATE OF POLLUTANTS
Organochlorine Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04437 5B

Migration and Speciation of Lead in a River System Heavily Polluted From a Smelter,
W85-04484 5B

Arsenic Speciation in Soil-Pore Waters From Mineralized and Unmineralized Areas of South-West England,
W85-04662 2K

Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

Biodegradation of Organic Chemicals,
W85-04797 5B

Dissipation of Permethrin in Limnocorrals,
W85-04838 5B

Biological Availability of Metals to Marine Organisms,
W85-04891 5B

PCBs, DDTs and Other Chlorinated Hydrocarbons in Marine Organisms from the Mediterranean Coast of Israel,
W85-04894 5B

FERTILIZATION
Experimental Lake Fertilization: Turnover of Nitrogen and Phosphorus in Stratified and Non-Stratified Subarctic Lakes in Northern Sweden,
W85-04534 2H

Simulated Effects of Fertilizer Management on Nitrate Loss with Tile Drainage Water for Continuous Corn,
W85-04739 6G

FERTILIZERS
Responses of Lake Whitefish (Coregonus clupeaformis) to Fertilization of Lake 226, the Experimental Lakes Area,
W85-04840 8I

Responses of Sockeye Salmon (Oncorhynchus nerka) to Fertilization of British Columbia Coastal Lakes,
W85-04847 8I

FETCH
Amazon Floodplain Lakes: Shape, Fetch, and Stratification,
W85-04568 2H

FILTERS
Filter Foam - Perfect in Many Fields (Filterschaum - Perfekt in Vielen Bereichen),
W85-04632 5F

FILTRATION
Comparison of Current Methods of Poliovirus Concentration from Tap Water,
W85-04492 5F

Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

Removal of New Indicators by Coagulation and Filtration,
W85-04833 5F

Bacterial Colonization of Point-of-Use Water Treatment Devices,
W85-04834 5F

Influence of Suspended Particle Size Distribution in Deep-Bed Filtration,
W85-04876 5F

FINLAND
Light Penetration and Some Related Characteristics in Small Forest Lakes in Southern Finland,
W85-04542 2H

Phytoplankton in 151 Eastern Finnish Lakes: Species Composition and its Relations to the Water Chemistry,
W85-04543 2H

FINNEMARKA
Conceptual Model of Lake Acidification,
W85-04531 5C

FIRE
Fire and Herbivory in a Great Salt Lake Marsh,
W85-04825 2L

FISH
Subsampling Program for the Estimation of Fish Impingement,
W85-04604 5C

Relationships Between Woody Debris and Fish Habitat in a Small Warmwater Stream,
W85-04679 2E

Confinement and Water Quality-Induced Stress in Largemouth Bass,
W85-04680 5C

Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

Effect of Water Temperature Elevation on Incipient and Cumulative Fecundity of Batch-Spawning Tench, Tinca tinca (L.),
W85-04707 8I

Review of the Food and Drug Administration Risk Analysis for Polychlorinated Biphenyls in Fish,
W85-04775 5C

Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel,
W85-04863 5B

Simultaneous Exposure of English Sole (Parophrys vetulus) to Sediment-Associated Xenobiotics: Part 1 - Uptake and Disposition of 14C-Polychlorinated Biphenyls and 3H-Benzo(a)Pyrene,
W85-04870 5C

Alachlor Toxicity to a Freshwater Teleost Clarias batrachus,
W85-04885 5C

Phosphorus, Nitrogen, and Carbon Cycling by Fish Populations in Two Small Lowland Rivers in Poland,
W85-04888 5B

PCBs, DDTs and Other Chlorinated Hydrocarbons in Marine Organisms from the Mediterranean Coast of Israel,
W85-04894 5B

FISH BEHAVIOR
Factors Influencing Impingement of Fish by Lake Ontario Power Plants,
W85-04713 8I

Effects of Dechlorinated Seawater on Fish Behavior,
W85-04862 5D

Attraction of Fish to Mercury Vapour Light and Its Application in a Generating Station Forebay,
W85-04914 8I

FISH EGGS
Survival of Eggs and Alevins of Atlantic Salmon (Salmo salar) in Relation to the Chemistry of Interstitial Water in Redds in Some Acidic Streams of Atlantic Canada,
W85-04845 5C

FISH FARMING
Effect of Water Temperature Elevation on Incipient and Cumulative Fecundity of Batch-Spawning Tench, Tinca tinca (L.),
W85-04707 8I

FISH HANDLING FACILITIES
Attraction of Fish to Mercury Vapour Light and Its Application in a Generating Station Forebay,
W85-04914 8I

FISH MANAGEMENT
Responses of Sockeye Salmon (Oncorhynchus nerka) to Fertilization of British Columbia Coastal Lakes,
W85-04847 8I

FISH PHYSIOLOGY
Content and Chemical Form of Mercury and Selenium in Lake Ontario Salmon and Trout,
W85-04717 5C

FISH PONDS
Primary Production and Diurnal Variation in a Tropical Fish Pond,
W85-04852 5C

FISHING
Physical and Economic Impacts of Sedimentation on Fishing Activities; Nam Pong Basin, Northeast Thailand,
W85-04448 5C

FLOATING MARSHES
Vegetation and Primary Production in a Floating Freshwater Marsh in Louisiana,
W85-04855 2L

FLOATING PLANTS
Leaf Area as a Measure of Standing Crop of Floating Aquatic Macrophytes,
W85-04817 2H

FLOCCULATION
Comparison of Current Methods of Poliovirus Concentration from Tap Water,
W85-04492 5F

Chemical Flocculation for Suspended Solids Removal at Remote Mine Sites,
W85-04730 5D

FLOOD CONTROL RESERVOIRS
Factors Influencing the Behaviour of De-Icing Salts in an Urban Flood Control Reservoir,
W85-04584 5B

FLOOD WARNINGS
Markov Flow Models and the Flood Warning Problem,
W85-04795 2E

FLOODPLAIN MANAGEMENT
Floodplain Policy and Practice in the Credit River Watershed, Ontario,
W85-04587 6F

FLORIDA
Manatee Use of Power Plant Effluents in Brevard County, Florida,
W85-04696 5C

Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

Phytoplankton Responses to Reduction and Elimination of Submerged Vegetation by Herbicides and Grass Carp in Four Florida Lakes,
W85-04857 5G

FLOW BALANCING METHOD
Flow Balancing System for Stormwater and Combined Sewer Overflow,
W85-04772 5D

FLOW-INJECTION ANALYSIS
Determination of Trace Amounts of Heavy Metals in Waters by a Flow-Injection System Including Ion-Exchange Preconcentration and Flame Atomic Absorption Spectrometric Detection,
W85-04653 5A

FLOW NETS
Field Method to Determine Unsaturated Hydraulic Conductivity Using Flow Nets,
W85-04791 2G

FLOW REGULATORS
Flow Balancing System for Stormwater and Combined Sewer Overflow,
W85-04772 5D

FLOW ROUTING
Comparison of Dynamic Flow Routing Methods for Urban Drainage Systems (Vergleich hydrodynamischer Berechnungsansatze zur Abflubermittlung in Kanalnetzen),
W85-04627 8B

FLUID DROPS
Sprinkler Droplet Size Distribution Estimation from Single Leg Test Data,
W85-04745 8C

FLUID TRANSPORT
Fluid Transport Processes in Upper Spencer Gulf,
W85-04762 2L

FLUIDIZED BED PROCESS
Biological Denitrification in a Fluidized Bed,
W85-04660 5D

FLUIDIZED BEDS
Aerobic Treatment in 'Oxitron' Biological Fluidized Bed Plant at Coleshill,
W85-04593 5D

FLUORIDE
Importance of Speciation Methods in Analytical Control of Water Treatment Processes With Application to Fluoride Removal From Waste Waters,
W85-04485 5A

FLUSHING
Cellular Phosphorus Concentration as a Criterion for Trophic Status in Rapidly Flushed Lakes,
W85-04846 2H

FOAM FILTERS
Filter Foam - Perfect in Many Fields (Filterschaum - Perfekt in Vielen Bereichen),
W85-04632 5F

FOOD HABITS
Oyster Reefs as Processors of Estuarine Materials,
W85-04483 2L

FOREBAYS
Attraction of Fish to Mercury Vapour Light and Its Application in a Generating Station Forebay,
W85-04914 8I

FOREST HYDROLOGY
Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

FORESTS
Effect of Anthropogenous Changes of Water Conditions on the Vegetation in the Forest Reserve Las Bielanski in Warsaw (Wplyw antropogennych zmian stosunkow wodnych na roslinnosc rezerwatu Las Bielanski w Warszawie),
W85-04610 4C

Irrigation of Swine Lagoon Effluent onto Pine and Hardwood Forests,
W85-04741 5D

FOUNDATIONS
Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

FRACTIONATION
Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

FRANCE
Atmospheric Heavy Metals in High Altitude Surface Snows From Mont Blanc, French Alps,
W85-04501 5B

Evolution of the Community at a Station Exposed to Sewage (Marseille-Cortiou) (Evolution Du Peuplement D'une Station Soumise A Des Apports D'Eaux D'Egout (Marseille-Cortiou)),
W85-04709 5C

Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

FRENCH ALPS
Atmospheric Heavy Metals in High Altitude Surface Snows From Mont Blanc, French Alps,
W85-04501 5B

FRESNO
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

FUEL
Revolutionary Experiments Turn Sludge into Fuel,
W85-04771 5E

FURROW IRRIGATION
Tillage Influences on Erosion During Furrow Irrigation,
W85-04749 4C

FUZZY SET THEORY
Theory of Fuzzy Subsets and Its Applications to Water-Resources Planning (Die Theorie unscharfer Teilmengen und ihre Anwendung in der Wasserwirtschaft),
W85-04806 6A

GALLIUM
Dithiocarbamate Extraction of Gallium from Natural Waters and from Biological Samples for Neutron Activation Analysis,
W85-04961 5A

GARRISON DIVERSION UNIT
Garrison Diversion Unit - An Update,
W85-04574 4A

GAS CHROMATOGRAPHY
Capillary Gas Chromatography Determination of Volatile Organic Acids in Rain and Fog Samples,
W85-04959 5A

GEOCHEMISTRY
Geochemistry of Inorganic Germanium In Natural Waters,
W85-04482 2K

Sedimentology and Geochemistry of Modern Sediments in the Kingston Basin of Lake Ontario,
W85-04714 2H

GEOHYDROLOGY
Brackish Water in Unsaturated Confining Beds at a Texas Lignite Mine,
W85-04639 2F

GEOLOGY
Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

GEOMORPHOLOGY
Sedimentology and Geochemistry of Modern Sediments in the Kingston Basin of Lake Ontario,
W85-04714 2H

GEORGIA
Nutrient Budgets for Agricultural Watersheds in the Southeastern Coastal Plain,
W85-04826 6G

GERMANIUM
Geochemistry of Inorganic Germanium In Natural Waters,
W85-04482 2K

Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

GERMANY (DEMOCRATIC REPUBLIC)
Qualitative and Quantitative Entomofaunistic Investigation of an Opencast Residual Lake near Leipzig (GDR),
W85-04906 2H

GERMANY (FEDERAL REPUBLIC)
Design and Operation of the Purification Lakes in the Ruhr Valley,
W85-04459 5G

Distribution, Dynamic and Structure of Free Dissolved Carbohydrates in the Plussee, a North German Eutrophic Lake,
W85-04552 2H

Methanogenesis in Sediments of Eutrophic Lakes; 2. Comparative Investigations on the Methane-Precursor Preference,
W85-04554 2H

Study of Waterworks in the Mannheim/Heidelberg Urban Area Using the Example of the Rheinau RHE Waterworks (Wasserwerksbetriebe im Ballungsraum Mannheim/Heidelberg am Beispiel des RHE-Wasserwerkes Rheinau),
W85-04626 5F

'Rennfeld' Small-Scale Hydroelectric Power Plant Near Pforzheim (Kleinwasserkraftanlage 'Rennfeld' bei Pforzheim),
W85-04629 8A

Studies on the Carbon Flux from Phyto- to Bacterioplankton Communities in Lake Constance,
W85-04672 2H

Method to Measure Suspended Load Transports in Estuaries,
W85-04675 2L

Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Frisian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland),
W85-04808 5B

GHANA
Chemical Survey of the Volta Estuary,
W85-04854 2L

GIARDIA
Giardia Lamblia and Water Supply,
W85-04829 5F

Removing Giardia Cysts with Slow Sand Filtration,
W85-04831 5F

Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

GIARDIASIS
Causes of a Waterborne Giardiasis Outbreak,
W85-04830 5F

GLACIER SURGES
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

GLACIERS
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

Concentrations of Seabirds Along the Face of Glaciers and Outlets of Rivers in Svalbard (Konsentrasjoner av sjofugl langs kanten av isbreer og utenfor breelver pa Svalbard),
W85-04608 2L

GLUCOSE
Effect of Some Heavy-metals on Glucose Assimilation in Polluted Waters,
W85-04705 5C

Microbial Heterotrophic Activity Assessment in a Waste-water Treatment System,
W85-04706 5D

GRANDE RIVIERE DE LA BALEINE
Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

GRASSLANDS
Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

GRAZING
Zooplankton and its Grazing as Measures of Trophy in the Loosdrecht Lakes,
W85-04548 2H

Fire and Herbivory in a Great Salt Lake Marsh,
W85-04825 2L

GREAT LAKES
Subchronic Effects of a Mixture of 'Persistent' Chemicals Found in the Great Lakes,
W85-04479 5C

Apples and Oranges: Toward a Critique of Public Participation in Great Lakes Decisions,
W85-04573 6A

GREAT OUSE BASIN
Monitoring of River Water Quality within the Great Ouse Basin Using the Chironomid Exuvial Analysis Technique,
W85-04454 5A

GREAT SALT LAKE
Fire and Herbivory in a Great Salt Lake Marsh,
W85-04825 2L

GREEN LAKE
Biomanipulation Experiment in Green Lake, Seattle, Washington,
W85-04671 5G

GREENLAND
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

GROUND MOVEMENT
Prediction and Control of Ground Movement Associated with Trench Excavation,
W85-04516 8D

GROUNDWATER
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

Multistage Model for the Development of Hydrochemical Zonation in Chalk Ground Waters,
W85-04634 2K

Distribution of Carbonates, Bicarbonates, and pH Values in Ground Water of the Nile Delta Region, Egypt,
W85-04638 2K

Effect of Agricultural Land Use on Groundwater Quality in a Small Pennsylvania Watershed,
W85-04642 5B

GROUNDWATER CONTAMINATION
Groundwater Quality Protection: The Issue in Perspective,
W85-04683 5G

GROUNDWATER MINING
LGWRES - Life of Ground-Water Reserves,
W85-04643 4B

GROUNDWATER MOVEMENT
Potential Effects on Ground Water of a Hypothetical Surface Coal Mine in Indiana,
W85-04418 4C

Stochastic Modeling of Groundwater Flow by Unconditional and Conditional Probabilities: The Inverse Problem,
W85-04793 2F

GROUNDWATER POLLUTION
Groundwater Source of Nitrate in Nearshore Marine Sediments,
W85-04616 5B

Migration and Attenuation of Selected Organics in a Sandy Aquifer - A Natural Gradient Experiment,
W85-04635 5B

Ground-Water Contamination and Well Construction in Southeast Nebraska,
W85-04637 5B

Nitrogen-Isotope Ratios of Nitrate in Ground Water Under Fertilized Fields, Long Island, New York,
W85-04641 5B

Main Results of a Project for Artificial Groundwater Recharge from Secondarily Treated Sewage in the Municipal Forest of the City of Langen (Lower Main Region) (Die wichtigsten Ergebnisse eines Projektes zur kunstlichen Grundwasser-anreicherung mit weitergehend behandeltem Abwasser im Langener Stadtwald (Untermainregion)),
W85-04809 5D

GROUNDWATER POTENTIAL
Brackish Groundwater as an Alternative Source of Cooling Water for Nuclear Power Plants in Israel,
W85-04599 4B

GROUNDWATER RECHARGE
Effects of the Recharge on Sewage Effluents Upon the Quality of Chalk Groundwater,
W85-04462 5C

Role of Specific Yield in Ground-Water Recharge Estimations: A Numerical Study,
W85-04640 2F

Groundwater Seepage and the Water Balance of a Closed, Freshwater, Coastal Dupe Lake: Lake Windermere, Jervis Bay,
W85-04698 2F

GROUNDWATER SAMPLING
Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

GROWTH
Effects of Mercury on the Prosobranch Mollusc Crepidula fornicata: Acute Lethal Toxicity and Effects on Growth and Reproduction of Chronic Exposure,
W85-04867 5C

GUANANBARA BAY
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

GULF OF MEXICO
Radium Variability Produced by Shelf-water Transport and Mixing in the Western Gulf of Mexico,
W85-04712 2K

HABITAT LOSS
Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

HABITATS
Typhetum angustifoliae and Typhetum latifoliae as Indicators of Various Habitats,
W85-04614 2L

Human Modification of Molluscan Habitats in Little Creek Estuary, Virginia,
W85-04859 6G

HAIFA BAY
Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel,
W85-04863 5B

HALOCARBONS
Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

HALOGENATED HYDROCARBONS
Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

HALOPHYTES
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

HANGING MERCURY DROP ELECTRODES
Determining Trace Concentrations of Copper in Water by Cathodic Film Stripping Voltammetry With Adsorptive Collection,
W85-04410 5A

HARE LAKE
Assessment of Historical Change in Two Northern Minnesota Lakes,
W85-04602 5B

HARZ MOUNTAINS
Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

HAVANT
Nutrient Removal Trials and Bioassay Evaluation at Budds Farm Sewage-Treatment Works, Havant,
W85-04526 5D

HAWEA RIVER
Preliminary Investigation on Effects of Fluctuating Flows on Invertebrates of the Hawea River, a Large Regulated River in New Zealand,
W85-04668 2H

HAZARDOUS WASTE DISPOSAL
Environmental Impact of Two, Adjacent, Hazardous Waste Disposal Sites in the Niagara River Watershed,
W85-04718 5C

HEATED WATER
Some Remarks on the Ecology of Algae in Heated Waters (Uwagi o ekologii glonow w wodach podgrzanych),
W85-04609 5C

HEATING
Heating Enclosed Wastewater Treatment Facilities with Heat Pumps,
W85-04924 6A

HEAVY METALS
Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies,
W85-04435 5C

Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas,
W85-04480 5B

Atmospheric Heavy Metals in High Altitude Surface Snows From Mont Blanc, French Alps,
W85-04501 5B

Changes in the Extractabilities of the Heavy Metals in Water-Logged Sludge-Treated Soils,
W85-04514 5E

Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

Snow Pollution and Its Effect on Heavy Metals Load of the Kozlowa Gora Reservoir as Compared to Rain and River Water,
W85-04611 5B

Determination of Trace Amounts of Heavy Metals in Waters by a Flow-Injection System Including Ion-Exchange Preconcentration and Flame Atomic Absorption Spectrometric Detection,
W85-04653 5A

Effects of Four Heavy Metals on Survival and Hatching Rate of Artemia salina (L.),
W85-04674 5C

Effect of Some Heavy-metals on Glucose Assimilation in Polluted Waters,
W85-04705 5C

Tolerance to and Uptake of Lead in the Green Mussel, Perna viridis (L.),
W85-04708 5C

Content and Chemical Form of Mercury and Selenium in Lake Ontario Salmon and Trout,
W85-04717 5C

Short-Term Uptake of Heavy Metals by Periphyton Algae,
W85-04721 5B

Commercial Mining Technique Offers a New Approach to Removing Heavy Metals from Sludges,
W85-04767 5D

Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

Heavy Metals in the Bombay Harbour Area,
W85-04892 5C

HEIDELBERG
Study of Waterworks in the Mannheim/Heidelberg Urban Area Using the Example of the Rheinau RHE Waterworks (Wasserwerksbetriebe im Ballungsraum Mannheim/Heidelberg am Beispiel des RHE-Wasserwerkes Rheinau),
W85-04626 5F

HEPATITIS
Waterborne Outbreak of Hepatitis A in Meade County, Kentucky,
W85-04658 5C

HERBICIDES
Aquatic Toxicity of 2,6-Dichlorobenzamide (BAM), a Degradation Product of the Herbicide Dichlobenil,
W85-04944 5C

HETEROTROPHIC BACTERIA
Microbial Heterotrophic Activity Assessment in a Waste-water Treatment System,
W85-04706 5D

HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY
Trace Determination of Aldehydes in Water by High-Performance Liquid Chromatography,
W85-04622 5A

HIGHWAYS
Effects of Motorway Run-Off on the Ecology of Stream Algae,
W85-04466 5C

HIROSHIMA BAY
Prediction of Red Tide Occurrence by Means of Discriminant Analysis (in Japanese),
W85-04605 5C

HOUSING
Zero Side Yard Housing, Acceptance and Stormwater Management Implications,
W85-04580 4A

Opportunity Costs of Preserving Coastal Wetlands: A Case Study of a Recreational Housing Development,
W85-04754 6B

HUBBARD BROOK
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

HUDSON BAY
Garrison Diversion Unit - An Update,
W85-04574 4A

HUMBER ESTUARY
Pollution Control in the Humber Estuary,
W85-04453 5G

HUMUS
Efficiency of Liming in Acid, Humus-Influenced Lakes,
W85-04533 5G

HUNGARY
Eutrophication of Lake Balaton: Measurements, Modeling and Management,
W85-04562 5C

Wastewater Disposal and Utilization in Agriculture in Poland and Hungary,
W85-04664 5E

Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

Extension of a Streamflow Time Series by Regression (Verlangerung einer Zeitreihe des Durchflusses mit Hilfe eines Regressionsmodells),
W85-04807 2E

HUSUM ESTUARY
Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Frisian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und

eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland),
W85-04808 5B

HUVEAUNE RIVER
Evolution of the Community at a Station Exposed to Sewage (Marseille-Cortiou) (Evolution Du Peuplement D'une Station Soumise A Des Apports D'Eaux D'Egout (Marseille-Cortiou)),
W85-04709 5C

HYDRAULIC MODELS
Hydraulic Modelling at the Piedra del Aguila Dam,
W85-04781 8B

HYDRAULICS
Mathematical Modeling of Hydraulic Regimes in the Transition Between the Surge Tank and Conduits of a Hydroelectric Station,
W85-04419 8B

Kinematic Structure of Flow in a Trapezoidal Channel,
W85-04421 8B

HYDROCARBONS
Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

HYDROELECTRIC PLANTS
Underwater Piercing of a Tunnel,
W85-04415 8A

Mathematical Modeling of Hydraulic Regimes in the Transition Between the Surge Tank and Conduits of a Hydroelectric Station,
W85-04419 8B

High-Head Spillway with Swirling of the Flow in the Outlet Section,
W85-04420 8A

Experience in the Operation of Hydraulic Structures and Equipment of Hydroelectric Stations,
W85-04423 8C

Masinga Dam in Kenya,
W85-04471 8A

Effects of Power Station Cooling Water Discharges on Aquatic Ecology,
W85-04507 5C

Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

Increasing Interest of Public Electricity Suppliers in Micro Power Plants (Aufleben kleiner Wasserkrafte auch beim offentlichen Elektrizitatsversorgungsunternehmen),
W85-04628 6C

'Rennfeld' Small-Scale Hydroelectric Power Plant Near Pforzheim (Kleinwasserkraftanlage 'Rennfeld' bei Pforzheim),
W85-04629 8A

Hydraulic Modelling at the Piedra del Aguila Dam,
W85-04781 8B

Environmental Management Planning for Dams and Hydro Schemes.
W85-04784 6G

Algorithms for Optimizing Hydropower System Operation,
W85-04786 4A

Role of Small Hydro in Rural Electrification,
W85-04949 6B

HYDROELECTRIC POWER
Low-Head Hydropower for Local Use,
W85-04620 6B

Future of Hydropower in Brazil,
W85-04779 6B

Integrated Planning System for Hydro Development in Ecuador,
W85-04780 6A

Small Hydro in China: Progress and Prospects,
W85-04947 6B

Exploiting Seasonal Energy from Small Hydropower Stations,
W85-04948 6B

Large Hydropower Stations in China,
W85-04951 6B

HYDROELECTRIC PROJECTS
Sedimentation in New Zealand Hydroelectric Schemes,
W85-04445 2J

HYDROGEN ION CONCENTRATION
Rainborne SO2, Precipitation pH and Airborne SO2 Over Short Sampling Times Throughout Individual Events,
W85-04500 5B

Evaluation of Acidification Based on Former Colorimetric Determination of pH: The Effect of Indicators on pH in Poorly Buffered Water,
W85-04530 5A

Distribution of Carbonates, Bicarbonates, and pH Values in Ground Water of the Nile Delta Region, Egypt,
W85-04638 2K

Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

Influence of pH and Ionic Strength on the Aqueous-Nonaqueous Distribution of Chlorinated Phenols,
W85-04803 5B

Blue-green Dominance in Lakes: The Role and Management Significance of pH and CO2,
W85-04909 2H

HYDROGEN ISOTOPES
D/H Ratios of Sap in Trees: Implications for Water Sources and Tree Ring D/H Ratios,
W85-04758 2I

HYDROGEN PEROXIDE
Tip Leachate Treatment Using Hydrogen Peroxide,
W85-04522 5D

HYDROGRAPHS
Reservoir Storage Equation Experimentally Verified,
W85-04416 2E

HYDROLOGIC BUDGET
Effect of Anthropogenous Changes of Water Conditions on the Vegetation in the Forest Reserve Las Bielanski in Warsaw (Wplyw antropogennych zmian stosunkow wodnych na roslinnosc rezerwatu Las Bielanski w Warszawie),
W85-04610 4C

Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

HYDROLOGIC MODELS
Interflow Model: I. Model Development,
W85-04577 2A

Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

HYDROLOGY
Measurements and Estimation in Hydrology - Ideas and Proposals for the Quantification of Errors and Uncertainties (Messungen und Schatzungen in der Hydrologie - Gedanken und Vorschlage zur Quantifizierung der Fehler und Unsicherheiten),
W85-04805 7B

HYPEREUTROPHIC LAKES
Variation of Water Quality Parameters in Meso- to Hypereutrophic Lakes,
W85-04536 2H

ICE COVER
Thickness of Ice on Perennially Frozen Lakes,
W85-04883 2C

ICE DRIVES
Trees Scars to Determine the Frequency and Stage of High Magnitude River Ice Drives and Jams, Red Deer, Alberta,
W85-04589 7B

ICE JAMS
Trees Scars to Determine the Frequency and Stage of High Magnitude River Ice Drives and Jams, Red Deer, Alberta,
W85-04589 7B

ICE SHEETS
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

ICEBERGS
Use of Icebergs to Supply Water (Die Verwendung von Eisbergen zur Wasserversorgung),
W85-04625 3B

ICED LAKES
Modelling Winter Oxygen Depletion Rates in Ice-Covered Temperate Zone Lakes in Canada,
W85-04843 2H

IDAHO
Species Richness in Streams of Different Size from the Same Drainage Basin,
W85-04665 2H

Rangeland Erosion Measurements for the USLE,
W85-04728 2J

IMMATURE GROWTH STAGES
Survival of Eggs and Alevins of Atlantic Salmon (Salmo salar) in Relation to the Chemistry of Interstitial Water in Redds in Some Acidic Streams of Atlantic Canada,
W85-04845 5C

IMPINGEMENT
Subsampling Program for the Estimation of Fish Impingement,
W85-04604 5C

Factors Influencing Impingement of Fish by Lake Ontario Power Plants,
W85-04713 8I

INDIA
Problems with Traditional Small Reservoir Irrigation Systems in the Semi Arid Tropics,
W85-04747 4A

Heavy Metals in the Bombay Harbour Area,
W85-04892 5C

Sediment Composition, Mud-water Interchanges and the Role of Macrophytes in Dal Lake, Kashmir,
W85-04904 2H

Influence of Water Hyacinth Cover on the Physico-Chemical Characteristics of Water and Phytoplankton Composition in a Reservoir near Jaipur (India),
W85-04913 5C

INDIAN OCEAN
Composition of Precipitation on Amsterdam Island, Indian Ocean,
W85-04503 5B

INDIAN RIVER
Manatee Use of Power Plant Effluents in Brevard County, Florida,
W85-04696 5C

INDIANA
Potential Effects on Ground Water of a Hypothetical Surface Coal Mine in Indiana,
W85-04418 4C

INDICATOR ORGANISMS
Use of Bacteriological Indicators for Swimming Water Quality,
W85-04765 5A

Removal of New Indicators by Coagulation and Filtration,
W85-04833 5F

INDICATORS
Evaluation of Acidification Based on Former Colorimetric Determination of pH: The Effect of Indicators on pH in Poorly Buffered Water,
W85-04530 5A

INDONESIA
Watershed Rehabilitation Program Related to the Management of River and Reservoir Sedimentation in Indonesia,
W85-04438 4D

INDUSTRIAL WASTES
Problems Associated with the Disposal of Trade Effluent to Sewers - Charging and Control,
W85-04463 5E

Industrial Effluent Control in the Netherlands and Legislation in this Field in Some Other European Countries,
W85-04520 5G

Toxicity of Effluents from a TiO2 Plant to the Harpacticoid Copepod Nitocra spinipes Boeck,
W85-04866 5C

Control and Treatment Technology for the Metal Finishing Industry. In-Plant Changes.
W85-04929 5D

Control and Treatment Technology for the Metal Finishing Industry. Ion Exchange.
W85-04931 5D

Decomissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

Chlorophenols and Their Impurities in the Canadian Environment: 1983 Supplement,
W85-04941 5B

INDUSTRIAL WASTEWATER
Importance of Speciation Methods in Analytical Control of Water Treatment Processes With Application to Fluoride Removal From Waste Waters,
W85-04485 5A

Control and Treatment Technology for the Metal Finishing Industry. In-Plant Changes.
W85-04929 5D

Control and Treatment Technology for the Metal Finishing Industry. Ion Exchange.
W85-04931 5D

INDUSTRIAL WASTEWATERS
Fate of Contaminants During Treatment of H-Coal Process Wastewaters,
W85-04878 5D

INFILTRATION
Infiltration in Swelling Soils,
W85-04790 2G

INFORMATION SYSTEMS
Doing a Job on Data,
W85-04651 7C

INSECTICIDES
Organochlorine Insecticides and PCBs in Water, Sediment, and Fish from the Mediterranean Sea,
W85-04473 5B

INTAKE GATES
Factors Influencing Impingement of Fish by Lake Ontario Power Plants,
W85-04712 8I

INTERCEPTION
Rainfall Interception on a Small Forested Watershed within the Kawartha Lakes Region,
W85-04578 2I

INTERFLOW
Interflow Model: I. Model Development,
W85-04577 2A

Interflow Model: II. Model Validation,
W85-04579 2A

INTERNATIONAL JOINT COMMISSION
Garrison Diversion Unit - An Update,
W85-04574 4A

INTERNATIONAL LAW
International Water Management in Canadian-American Relations, 1894-1907,
W85-04588 6E

INTERSTITIAL WATER
Arsenic Speciation in Soil-Pore Waters From Mineralized and Unmineralized Areas of South-West England,
W85-04662 2K

Survival of Eggs and Alevins of Atlantic Salmon (Salmo salar) in Relation to the Chemistry of Interstitial Water in Redds in Some Acidic Streams of Atlantic Canada,
W85-04845 5C

INVERTEBRATES
Species Richness in Streams of Different Size from the Same Drainage Basin,
W85-04665 2H

Preliminary Investigation on Effects of Fluctuating Flows on Invertebrates of the Hawea River, a Large Regulated River in New Zealand,
W85-04668 2H

Analysis of Changes in the Invertebrate Community Along a Southern New Zealand Montane Stream,
W85-04724 2H

Predicting the Effect of Macrobenthos on the Sediment/Water Flux of Metals and Phosphorus,
W85-04839 2K

Responses of Benthic Macroinvertebrate Species to Manipulation of Interstitial Detritus in Carnation Creek, British Columbia,
W85-04841 2H

Quantification of Stream Drift,
W85-04842 2H

Shredder Abundance and Leaf Breakdown in an Appalachian Mountain Stream,
W85-04899 2H

IODINE
Application of Ion-Exchange Chromatography with an Ion-Selective Electrode Detector to Iodine Determination in Natural Waters,
W85-04654 5A

ION CHROMATOGRAPHY
Ion Chromatographic Determination of Silicic Acid in Natural Water,
W85-04623 2K

ION EXCHANGE
Determination of Trace Amounts of Heavy Metals in Waters by a Flow-Injection System Including Ion-Exchange Preconcentration and Flame Atomic Absorption Spectrometric Detection,
W85-04653 5A

Control and Treatment Technology for the Metal Finishing Industry. Ion Exchange.
W85-04931 5D

ION EXCHANGE CHROMATOGRAPHY
Application of Ion-Exchange Chromatography with an Ion-Selective Electrode Detector to Iodine Determination in Natural Waters,
W85-04654 5A

ION SELECTIVE ELECTRODE
Application of Ion-Exchange Chromatography with an Ion-Selective Electrode Detector to Iodine Determination in Natural Waters,
W85-04654 5A

IONIC INTERACTIONS
Effect of Ionic Interactions on the Oxidation of Metals in Natural Waters,
W85-04761 2K

IONIC STRENGTH
Influence of pH and Ionic Strength on the Aqueous-Nonaqueous Distribution of Chlorinated Phenols,
W85-04803 5B

IONS
Spatial Distributions of Precipitation Acidity and Major Ion Wet Deposition in North America During 1980,
W85-04647 5B

Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes,
W85-04789 5C

IOWA
Runoff and Sediment Transport Within and From Small Agricultural Watersheds,
W85-04734 2J

IRON
Effect of Ionic Interactions on the Oxidation of Metals in Natural Waters,
W85-04761 2K

IRON OXYHYDROXIDES
Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides,
W85-04757 5B

IRRADIANCE
Factors Affecting Clarity of New Zealand Lakes,
W85-04670 2H

IRRIGATION EFFICIENCY
Problems with Traditional Small Reservoir Irrigation Systems in the Semi Arid Tropics,
W85-04747 4A

IRRIGATION MANAGEMENT
Managing Summer Lawn Irrigation Demands: A Water Use Index,
W85-04694 3D

IRRIGATION OPERATION
Integrated Water-Energy Management System for Center Pivot Irrigation: Functional Requirements,
W85-04742 7C

Integrated Water-Energy Management System for Center Pivot Irrigation: Implementation,
W85-04743 7C

IRRIGATION SCHEDULING
Irrigation Scheduling Under Saline High Water Tables,
W85-04744 3F

IRRIGATION WATER
Saline Irrigation Water: Effects on Soil Chemical and Physical Properties,
W85-04618 3C

Effects of Electricity Rates and Rate Structures on Pump Irrigation: An Eastern Colorado Case Study,
W85-04752 3F

ISRAEL
Brackish Groundwater as an Alternative Source of Cooling Water for Nuclear Power Plants in Israel,
W85-04599 4B

Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel,
W85-04863 5B

ITALY
Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

JAMAICA
Water Relations of Jamaican Upper Montane Rain Forest Trees,
W85-04824 2I

JAMES RIVER
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

JAMIESON CREEK WATERSHED
Interflow Model: II. Model Validation,
W85-04579 2A

JAMUNA RIVER
Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

JAPAN
Determination of Trialkyl and Triaryl Phosphates in Environmental Samples,
W85-04497 5B

Impact of Nutrient Load on Total Biomass and Species Succession in Lake Suwa, Japan,
W85-04565 5C

Prediction of Red Tide Occurrence by Means of Discriminant Analysis (in Japanese),
W85-04605 5C

Inorganic Nutrients Occurring in the Oxygen-deficient Bottom Water of Osaka Bay,
W85-04606 2K

JEDDAH
Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 1. Environmental Conditions,
W85-04710 5C

Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 2. Nutrient Salts,
W85-04711 5C

JERVIS BAY
Groundwater Seepage and the Water Balance of a Closed, Freshwater, Coastal Dune Lake: Lake Windermere, Jervia Bay,
W85-04698 2F

JUKSKEI RIVER
Diatoms of the Jukskei-Crocodile River System (Transvaal, Republic of South Africa): A Preliminary Check-List,
W85-04814 2H

KEJIMKUJIK LAKE
Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

KENTUCKY
Waterborne Outbreak of Hepatitis A in Meade County, Kentucky,
W85-04658 5C

KENYA
Masinga Dam in Kenya,
W85-04471 8A

Recent Changes in the Ecology of Lake Naivasha, Kenya,
W85-04566 2H

KINGSTON BASIN
Sedimentology and Geochemistry of Modern Sediments in the Kingston Basin of Lake Ontario,
W85-04714 2H

KITAKYUSHU CITY
Determination of Trialkyl and Triaryl Phosphates in Environmental Samples,
W85-04497 5B

KLEINER UKLEISEE
Methanogenesis in Sediments of Eutrophic Lakes; 2. Comparative Investigations on the Methane-Precursor Preference,
W85-04554 2H

KOGE BAY
Ecoepidemiology - A Casuistic Discipline Describing Ecological Disturbances and Damages in Relation to Their Specific Causes: Exemplified by Chlorinated Phenols and Chlorophenoxy Acids,
W85-04777 5C

KOZLOWA GORA RESERVOIR
Snow Pollution and Its Effect on Heavy Metals Load of the Kozlowa Gora Reservoir as Compared to Rain and River Water,
W85-04611 5B

KULKWITZ LAKE
Qualitative and Quantitative Entomofaunistic Investigation of an Opencast Residual Lake near Leipzig (GDR),
W85-04906 2H

LAGO CAMALEAO
Seasonal Variation of the Major Cation Content of the Varzea-Lake Lago Camaleao, Middle Amazon, Brazil, in 1981 and 1982,
W85-04570 2H

LAGOA DE OBIDOS
Investigation into the Hydraulic Resources of a Lagoon in Portugal,
W85-04461 5G

LAGOONS
Investigation into the Hydraulic Resources of a Lagoon in Portugal,
W85-04461 5G

Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance,
W85-04907 2L

LAKE ALSERIO
Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

LAKE BALATON
Eutrophication of Lake Balaton: Measurements, Modeling and Management,
W85-04562 5C

Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

LAKE BIENVILLE
Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

LAKE BOEUL
Vegetation and Primary Production in a Floating Freshwater Marsh in Louisiana,
W85-04855 2L

LAKE CALADO
Vertical Mixing in Amazon Floodplain Lakes,
W85-04569 2H

LAKE CHAMPLAIN
Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality,
W85-04753 6B

LAKE COMABBIO
Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

LAKE CONSTANCE
Impact of Sedimentation on the Phosphorus Content of the Euphotic Zone of Lake Constance,
W85-04555 2H

Studies on the Carbon Flux from Phyto- to Bacterioplankton Communities in Lake Constance,
W85-04672 2H

LAKE ERIE
Small Format, Hand Held Helicopter Based Photography for Monitoring Industrial Water Effluent Plumes,
W85-04586 7B

Seasonal Variation of Nutrient Limitation in Western Lake Erie,
W85-04719 2H

LAKE ESROM
Decline of Zoobenthos Through Five Decades of Eutrophication in Lake Esrom,
W85-04541 5C

LAKE GARDSJON
Short-term Effects of Liming on Sediment Oxygen Uptake in an Acid lake,
W85-04537 5G

LAKE GIM
Outdoor Recreation - A New Factor Disturbing Lake Ecosystems, as Exemplified by Lake Gim, Mazurian Lake District,
W85-04557 5C

LAKE HAVAGARDSJON
Small-scale Temporal Changes in the Biological and Chemical Composition of Surface Microlayers in a Eutrophic Lake,
W85-04538 2H

LAKE JEZERO
Model of Diatom Dynamics in the Epilimnion of Lake Jezero on the Island of Krk,
W85-04900 2H

Effects of Ecological Perturbations on Diatom Dynamics in the Model of Lake Jezero,
W85-04901 2H

LAKE LEMAN
5-alpha(H)-Cholestan-3-alpha-ol in Sediments: Characterization and Geochemical Significance,
W85-04759 2K

LAKE LILLA GALTSJON
Acidified Lakes: Ecosystem Response Folowing Sediment Treatment with Sodium Carbonate,
W85-04539 5G

LAKE LUGANO
Availability of Sediment P in Lake Lugano,
W85-04563 2H

Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

LAKE MARION
Quiescence, Growth and Senescence of Egeria densa in Lake Marion,
W85-04858 2H

LAKE MENDOTA
Zooplankton Dynamics in Lake Mendota: Short-term Versus Long-term Changes,
W85-04897 2H

LAKE MONATE
Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

LAKE MORPHOLOGY
Amazon Floodplain Lakes: Shape, Fetch, and Stratification,
W85-04568 2H

LAKE NAIVASHA
Recent Changes in the Ecology of Lake Naivasha, Kenya,
W85-04566 2H

LAKE ONTARIO
Factors Influencing Impingement of Fish by Lake Ontario Power Plants,
W85-04713 8I

Sedimentology and Geochemistry of Modern Sediments in the Kingston Basin of Lake Ontario,
W85-04714 2H

Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

Content and Chemical Form of Mercury and Selenium in Lake Ontario Salmon and Trout,
W85-04717 5C

Lake Ontario Oxygen Model. 1. Model Development and Application,
W85-04801 2H

Lake Ontario Oxygen Model. 2. Errors Associated with Estimating Transport Across the Thermocline,
W85-04802 2H

LAKE PONTCHARTRAIN
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

LAKE PUSIANO
Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

LAKE RESTORATION
Loosdrecht Lakes Restoration Project, an Introduction,
W85-04544 2H

Loosdrecht Lakes Restoration Project: Hydrology and Physico-Chemical Characteristics of the Lakes,
W85-04545 2H

LAKE ROTORUA
Trends in Lake Rotorua Water Quality,
W85-04669 2H

LAKE SEDIMENTS
Short-term Effects of Liming on Sediment Oxygen Uptake in an Acid lake,
W85-04537 5G

Acidified Lakes: Ecosystem Response Folowing Sediment Treatment with Sodium Carbonate,
W85-04539 5G

Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

Methanogenesis in Sediments of Eutrophic Lakes; 2. Comparative Investigations on the Methane-Precursor Preference,
W85-04554 2H

External and Internal Loading and Retention of Phosphorus in the R. Jorka Lakes (Masurian Lakeland, Poland) vs Their Trophic Status,
W85-04556 2H

Availability of Sediment P in Lake Lugano,
W85-04563 2H

Phosphorus in the Bottom Sediments of Some Lakes of the World,
W85-04612 2H

Sedimentology and Geochemistry of Modern Sediments in the Kingston Basin of Lake Ontario,
W85-04714 2H

Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides,
W85-04757 5B

5-alpha(H)-Cholestan-3-alpha-ol in Sediments: Characterization and Geochemical Significance,
W85-04759 2K

Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

Radiotracer Estimation of Microbial Biomass in Lake Sediment,
W85-04848 2H

Sediment Composition, Mud-water Interchanges and the Role of Macrophytes in Dal Lake, Kashmir,
W85-04904 2H

LAKE SUWA
Impact of Nutrient Load on Total Biomass and Species Succession in Lake Suwa, Japan,
W85-04565 5C

LAKE TITICACA
Diurnal Cycle of Stratification in Lake Titicaca: Eddy Diffusion,
W85-04567 2H

Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

LAKE TJEUKEMEER
Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

LAKE VARESE
Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

LAKE VECHTEN
Carbon Mineralization in Microaerobic and Anaerobic Strata of Lake Vechten (The Netherlands): Diffusion Flux Calculations and Sedimentation Measurements,
W85-04702 2H

Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

LAKE WINDERMERE
Groundwater Seepage and the Water Balance of a Closed, Freshwater, Coastal Dune Lake: Lake Windermere, Jervis Bay,
W85-04698 2F

LAKES
Phytoplankton in a Polluted Subarctic Lake Before and After Nutrient Reduction,
W85-04490 5C

Conceptual Model of Lake Acidification,
W85-04531 5C

Experimental Lake Fertilization: Turnover of Nitrogen and Phosphorus in Stratified and Non-Statified Subarctic Lakes in Northern Sweden,
W85-04534 2H

Variation of Water Quality Parameters in Meso- to Hypereutrophic Lakes,
W85-04536 2H

Small-scale Temporal Changes in the Biological and Chemical Composition of Surface Microlayers in a Eutrophic Lake,
W85-04538 2H

Dissolved Organic Carbon in Danish Lakes: Concentration, Composition, and Lability,
W85-04540 5C

Light Penetration and Some Related Characteristics in Small Forest Lakes in Southern Finland,
W85-04542 2H

Phytoplankton in 151 Eastern Finnish Lakes: Species Composition and its Relations to the Water Chemistry,
W85-04543 2H

Macrophytes in the Loosdrecht Lakes: A Story of Their Decline in the Course of Eutrophication,
W85-04549 5C

Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

Modelling Eutrophication in Shallow Dutch Lakes,
W85-04551 5C

External and Internal Loading and Retention of Phosphorus in the R. Jorka Lakes (Masurian Lakeland, Poland) vs Their Trophic Status,
W85-04556 2H

Role of Bivalves in the Phosphorus and Nitrogen Budget in Lakes,
W85-04558 2H

Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions),
W85-04559 5G

Phytoplankton as Biological Parameter for the Trophic Characterization of Lakes,
W85-04561 2H

Vertical Mixing in Amazon Floodplain Lakes,
W85-04569 2H

Nutrient Processing in Amazon Floodplain Lakes,
W85-04571 2K

Protozoan Colonization Rates and Trophic Status of Some Freshwater Wetland Lakes,
W85-04657 2H

Aquatic Macrophyte Vegetation of an Isolated Island Lake Adjacent to Lake Nipigon, Ontario: A Comparative Study After a Fifty-six Year Interval,
W85-04661 2H

Trends in Lake Rotorua Water Quality,
W85-04669 2H

Factors Affecting Clarity of New Zealand Lakes,
W85-04670 2H

Possible Relationships Between Surface Water Chemistry and Aquatic Plants in the Northern Great Plains,
W85-04697 2H

Measurement and Comparative Values of the Short Circuit Metabolism (SCM) of Lakes by POC Relationship of Primary Production of Phytoplankton and Settling Matter,
W85-04701 2H

Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes,
W85-04789 5C

Responses of Lake Whitefish (Coregonus clupeaformis) to Fertilization of Lake 226, the Experimental Lakes Area,
W85-04840 8I

Thickness of Ice on Perennially Frozen Lakes,
W85-04883 2C

Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

LAND DEVELOPMENT
Opportunity Costs of Preserving Coastal Wetlands: A Case Study of a Recreational Housing Development,
W85-04754 6B

LAND DISPOSAL
Changes in the Extractabilities of the Heavy Metals in Water-Logged Sludge-Treated Soils,
W85-04514 5E

Macroinvertebrates in a Sewage-Polluted Aquifer,
W85-04720 5C

Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

LAND USE
Stream Phosphorus Exports from Prealpine Watersheds with Respect to Geology and Land Use,
W85-04560 5B

Effect of Agricultural Land Use on Ground-Water Quality in a Small Pennsylvania Watershed,
W85-04642 5B

LANDFILLS
Long-term Groundwater Protection with Plastic Linings (Langfristiger Grundwasserschutz mit Kunststoffdichtungsbahnen),
W85-04633 5G

LAS BIELANSKI FOREST RESERVE
Effect of Anthropogenous Changes of Water Conditions on the Vegetation in the Forest Reserve Las Bielanski in Warsaw (Wplyw antropogennych zmian stosunkow wodnych na roslinnosc rezerwatu Las Bielanski w Warszawie),
W85-04610 4C

LAWN IRRIGATION
Managing Summer Lawn Irrigation Demands: A Water Use Index,
W85-04694 3D

Lawn and Garden Watering Regulations: Conservation Through a Water Use Index,
W85-04695 3D

LEA MARSTON PURIFICATION LAKE
Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

LEACHATES
Tip Leachate Treatment Using Hydrogen Peroxide,
W85-04522 5D

Attenuation of Chemical Elements in Acidic Leachates from Coal Mineral Wastes by Soils,
W85-04600 5B

LEACHING
Comparison of Leaching Losses from Decomposing Litter of the Terrestrial and Marsh Plants on Land and in Water,
W85-04553 2L

Leaching of Tetrachloroethylene from Vinyl-Lined Pipe,
W85-04963 5F

LEAD
Migration and Speciation of Lead in a River System Heavily Polluted From a Smelter,
W85-04484 5B

Tolerance to and Uptake of Lead in the Green Mussel, Perna viridis (L.),
W85-04708 5C

Voltammetric Methods for Distinguishing between Dissolved and Particulate Metal Ion Concentrations in the Presence of Hydrous Oxides. A Case Study on Lead (II),
W85-04800 5A

LEAF AREA
Leaf Area as a Measure of Standing Crop of Floating Aquatic Macrophytes,
W85-04817 2H

LEAK DETECTION
Recent Developments in Leak Noise Correlation Techniques,
W85-04958 8G

LEAKAGE
Demand Reduction: Water Conservation Through Leak Detection,
W85-04691 3D

Water Leakage Control and Sonic Detection,
W85-04692 3D

LEAVES
Stomatal Responses to Leaf Water Potentials of Drip Irrigated Peach (Prunus persica),
W85-04746 2I

Shredder Abundance and Leaf Breakdown in an Appalachian Mountain Stream,
W85-04899 2H

LEECHES
Comparative Survey of the Erpobdella octoculata (L.) Populations in the Afon Crafnant, N. Wales, Above and Below an Input of Zinc from Mine-Waste,
W85-04886 5C

LEGAL ASPECTS
Arizona Water Issues: Contrasting Economic and Legal Perspectives,
W85-04756 6E

LEGISLATION
Industrial Effluent Control in the Netherlands and Legislation in this Field in Some Other European Countries,
W85-04520 5G

LEWES
Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

LIFE STAGES
Effects of Four Heavy Metals on Survival and Hatching Rate of Artemia salina (L.),
W85-04674 5C

LIGHT PENETRATION
Light Penetration and Some Related Characteristics in Small Forest Lakes in Southern Finland,
W85-04542 2H

LIMING
Efficiency of Liming in Acid, Humus-Influenced Lakes,
W85-04533 5G

Short-term Effects of Liming on Sediment Oxygen Uptake in an Acid lake,
W85-04537 5G

Acidified Lakes: Ecosystem Response Folowing Sediment Treatment with Sodium Carbonate,
W85-04539 5G

LIMITING NUTRIENTS
Seasonal Variation of Nutrient Limitation in Western Lake Erie,
W85-04719 2H

LIMNOCORRALS
Dissipation of Permethrin in Limnocorrals,
W85-04838 5B

LIMNOLOGY
Size Classes of 'Dissolved' Nutrients i. Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

LIMPETS
Effects of Mercury on the Prosobranch Mollusc Crepidula fornicata: Acute Lethal Toxicity and Effects on Growth and Reproduction of Chronic Exposure,
W85-04867 5C

LINEAR REGRESSION
Extension of a Streamflow Time Series by Regression (Verlangerung einer Zeitreihe des Durchflusses mit Hilfe eines Regressionsmodells),
W85-04807 2E

LININGS
Long-term Groundwater Protection with Plastic Linings (Langfristiger Grundwasserschutz mit Kunststoffdichtungsbahnen),
W85-04633 5G

LITHIUM CHLORIDE
Determination of Spreading of Nutritive Salts in Quasi-Stagnant Waters by Using Lithium (Chloride) as Tracer and Continuous Measurement of Water-Quality Parameters (Die Bestimmung von Ausbreitungsvorgangen von Nahrsalzen in quasi stehenden Gewassern unter Verwendung des Tracers Lithium (Chlorid) und die kontinuierliche Messung von Wasserguteparametern),
W85-04810 5A

LITTER
Comparison of Leaching Losses from Decomposing Litter of the Terrestrial and Marsh Plants on Land and in Water,
W85-04553 2L

LITTLE CREEK ESTUARY
Human Modification of Molluscan Habitats in Little Creek Estuary, Virginia,
W85-04859 6G

LITTORAL ZONES
Role of Bivalves in the Phosphorus and Nitrogen Budget in Lakes,
W85-04558 2H

LOBO RESERVOIR
Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

LOBSTERS
Trace Metal-Binding Proteins in Marine Molluscs and Crustaceans,
W85-04873 5C

LOCKS
Pressure Rises Due to Unsteady Flow, Especially in High-Lift Navigation Locks (Druckerhohungen aufgrund instationarer Stromungsvorgange, insbesondere in Schiffsschleusen mit grossen Stufenhohen),
W85-04631 8B

LONES
Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

LONG ISLAND
Nitrogen-Isotope Ratios of Nitrate in Ground Water Under Fertilized Fields, Long Island, New York,
W85-04641 5B

LOOOSDRECHT LAKES
Loosdrecht Lakes Restoration Project: Hydrology and Physico-Chemical Characteristics of the Lakes,
W85-04545 2H

LOOSDRECHT LAKES
Loosdrecht Lakes Restoration Project, an Introduction,
W85-04544 2H

Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

Seston-Epipelon Interrelationships in the Shallow Eutrophic Loosdrecht Lakes (The Netherlands),
W85-04547 2H

Zooplankton and its Grazing as Measures of Trophy in the Loosdrecht Lakes,
W85-04548 2H

Macrophytes in the Loosdrecht Lakes: A Story of Their Decline in the Course of Eutrophication,
W85-04549 5C

LOUISIANA
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

Vegetation and Primary Production in a Floating Freshwater Marsh in Louisiana,
W85-04855 2L

Effects of Soil Waterlogging on the Energy Status and Distribution of Salix nigra and S. exigua (Salicaceae) in the Atchafalaya River Basin of Louisiana,
W85-04943 2I

LOVE CANAL
Environmental Impact of Two, Adjacent, Hazardous Waste Disposal Sites in the Niagara River Watershed,
W85-04718 5C

LOW-HEAD
Low-Head Hydropower for Local Use,
W85-04620 6B

MACROINVERTEBRATES
Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

Macroinvertebrates in a Sewage-Polluted Aquifer,
W85-04720 5C

Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

MACROPHYTES
Detoxification of Effluents in a Macrophyte Treatment System,
W85-04489 5D

Macrophytes in the Loosdrecht Lakes: A Story of Their Decline in the Course of Eutrophication,
W85-04549 5C

Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

Aquatic Macrophyte Vegetation of an Isolated Island Lake Adjacent to Lake Nipigon, Ontario: A Comparative Study After a Fifty-six Year Interval,
W85-04661 2H

Leaf Area as a Measure of Standing Crop of Floating Aquatic Macrophytes,
W85-04817 2H

Studies on the Zoobenthos of Some Southern Cape, Coastal Lakes. Spatial and Temporal Changes in the Benthos of Swartvlei, South Africa, in Relation to Changes in the Submerged Littoral Macrophyte Community,
W85-04818 2H

Sediment Composition, Mud-water Interchanges and the Role of Macrophytes in Dal Lake, Kashmir,
W85-04904 2H

MACROPORES
Comparison of Field- and Laboratory-Measured and Predicted Hydraulic Properties of a Soil with Macropores,
W85-04617 2G

MAINE
Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

MAINTENANCE
Determining Extraneous Flows in Waste Water Systems,
W85-04689 8A

Relining: The Feasibility of Inserting Pipe into Existing Sewers,
W85-04693 8A

New Ideas Reshaping Treatment Technologies,
W85-04751 5D

1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures,
W85-04928 7B

MALAWI
Malawi - Driving a 9 m Diameter Power Conduit with Low Cover at Nkula Falls,
W85-04819 8A

MAMMALS
Manatee Use of Power Plant Effluents in Brevard County, Florida,
W85-04696 5C

MANAGEMENT
Managment of Sedimentation in Bangladesh,
W85-04440 2J

Cost-Effective Management - Revenue and Technical Monitoring,
W85-04519 6B

MANAGEMENT PLANNING
Reservoir Sedimentation in India -- Its Causes, Control, and Future Course of Action,
W85-04439 6G

Canadian Water Management: A One Armed Giant,
W85-04685 6A

Role of Pricing in Managing the Demand for Water,
W85-04686 6A

MANATEES
Manatee Use of Power Plant Effluents in Brevard County, Florida,
W85-04696 5C

MANITOBA
Garrison Diversion Unit - An Update,
W85-04574 4A

Modelling Winter Oxygen Depletion Rates in Ice-Covered Temperate Zone Lakes in Canada,
W85-04843 2H

MANNHEIM
Study of Waterworks in the Mannheim/Heidelberg Urban Area Using the Example of the Rheinau RHE Waterworks (Wasserwerksbetriebe im Ballungsraum Mannheim/Heidelberg am Beispiel des RHE-Wasserwerkes Rheinau),
W85-04626 5F

MANTARO TRANSFER PROJECT
Cost Sharing in a Multipurpose Water Project,
W85-04778 6C

MANURE
Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

MARINE ENVIRONMENT
delta 13C Measurements as Indicators of Carbon Flow in Marine and Freshwater Ecosystems,
W85-04431 2K

Radioecological Studies of Activation Products Released from a Nuclear Power Plant into the Marine Environment,
W85-04865 5B

Benthic-Pelagic Coupling in Sewage-Affected Marine Ecosystems,
W85-04874 5C

Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

Embryo Abnormalities in the Periwinkle, Littorina 'saxatilis', as Indicators of Stress in Polluted Marine Environments,
W85-04893 5A

MARINE ORGANISMS
Biological Availability of Metals to Marine Organisms,
W85-04891 5B

MARINE SEDIMENTS
Groundwater Source of Nitrate in Nearshore Marine Sediments,
W85-04616 5B

Effect of Effluent High in Chromium on Marine Sediment Aerobic Heterotrophic Bacteria,
W85-04869 5C

MARKOV FLOW MODELS
Markov Flow Models and the Flood Warning Problem,
W85-04795 2E

MARSEILLE
Evolution of the Community at a Station Exposed to Sewage (Marseille-Cortiou) (Evolution Du Peuplement D'une Station Soumise A Des Apports D'Eaux D'Egout (Marseille-Cortiou)),
W85-04709 5C

MARSH PLANTS
Pedologic Properties of New Jersey Tidal Marshes,
W85-04955 2L

MARSHES
Fire and Herbivory in a Great Salt Lake Marsh,
W85-04825 2L

MARYLAND
Trace Metal Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04436 5B

Organochlorine Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04437 5B

MASINGA DAM
Masinga Dam in Kenya,
W85-04471 8A

MASONRY DAMS
Medium and Small Masonry Arch Dams in China,
W85-04950 8A

MASSACHUSETTS
Organochlorine Residues in Common Terns and Associated Estuarine Organisms, Massachusetts, USA, 1971-81,
W85-04861 5B

MATHEMATICAL EQUATIONS
Reservoir Storage Equation Experimentally Verified,
W85-04416 2E

Simplest Approximate Computation of Dambreak Waves (Die Einfachste Naherungsberechnung von Dammbruchwellen),
W85-04630 8B

Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; I. Equation Development,
W85-04787 5B

MATHEMATICAL MODELING
Mathematical Modeling of Hydraulic Regimes in the Transition Between the Surge Tank and Conduits of a Hydroelectric Station,
W85-04419 8B

MATHEMATICAL MODELS
Evaluation of a Moving-Co-ordinate System Model of Salinity Intrusion into the Mersey Estuary,
W85-04528 2L

Mathematical Model for Reservoir Sedimentation Planning,
W85-04785 6A

Lake Ontario Oxygen Model. 1. Model Development and Application,
W85-04801 2H

Lake Ontario Oxygen Model. 2. Errors Associated with Estimating Transport Across the Thermocline,
W85-04802 2H

MEADE COUNTY
Waterborne Outbreak of Hepatitis A in Meade County, Kentucky,
W85-04658 5C

MEASUREMENT INSTRUMENTATION
Hydraulic Conductivity Measured Electronically in an Auger Hole,
W85-04740 2G

MEASURING INSTRUMENTS
Method to Measure Suspended Load Transports in Estuaries,
W85-04675 2L

Near Bottom Variations of Turbidity in the St. Lawrence Estuary,
W85-04677 2L

MECHANICAL EQUIPMENT
Screening: A New Approach,
W85-04523 5D

MECHANICAL FAILURE
Investigation into the Failure of a Prestressed Rock Anchor,
W85-04952 8G

MEDITERRANEAN SEA
Organochlorine Insecticides and PCBs in Water, Sediment, and Fish from the Mediterranean Sea,
W85-04473 5B

PCBs, DDTs and Other Chlorinated Hydrocarbons in Marine Organisms from the Mediterranean Coast of Israel,
W85-04894 5B

MEDWAY ESTUARY
Development and Use of a Theoretical Mathematical Model for the Medway Estuary,
W85-04450 2L

MERCURY
Content and Chemical Form of Mercury and Selenium in Lake Ontario Salmon and Trout,
W85-04717 5C

Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel,
W85-04863 5B

Effects of Mercury on the Prosobranch Mollusc Crepidula fornicata: Acute Lethal Toxicity and Effects on Growth and Reproduction of Chronic Exposure,
W85-04867 5C

Decomissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

MERCURY POLLUTION
Decomissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

MERCURY VAPOR LIGHTS
Attraction of Fish to Mercury Vapour Light and Its Application in a Generating Station Forebay,
W85-04914 8I

MESOEUTROPHIC LAKES
Variation of Water Quality Parameters in Meso- to Hypereutrophic Lakes,
W85-04536 2H

MESOTROPHIC ECOSYSTEMS
Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

METAL-FINISHING WASTES
Control and Treatment Technology for the Metal Finishing Industry. In-Plant Changes.
W85-04929 5D

Control and Treatment Technology for the Metal Finishing Industry. Ion Exchange.
W85-04931 5D

METAL REMOVAL
Adsorption and Complexation Mechanisms of Heavy Metal Uptake in Activated Sludge,
W85-04411 5D

METALLOTHIONIENS
Trace Metal-Binding Proteins in Marine Molluscs and Crustaceans,
W85-04873 5C

METALS
Determining Trace Concentrations of Copper in Water by Cathodic Film Stripping Voltammetry With Adsorptive Collection,
W85-04410 5A

Copper Complexation and Toxicity to Daphnia in Natural Waters,
W85-04716 5C

Predicting the Effect of Macrobenthos on the Sediment/Water Flux of Metals and Phosphorus,
W85-04839 2K

Biological Availability of Metals to Marine Organisms,
W85-04891 5B

METHANE
Methanogenesis in Sediments of Eutrophic Lakes; 2. Comparative Investigations on the Methane-Precursor Preference,
W85-04554 2H

Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

METHANOGENESIS
Effects of Organic Pollutants on Methanogenesis, Sulfate Reduction and Carbon Dioxide Evolution in Salt Marsh Sediments,
W85-04872 5C

METHYLENE CHLORIDE
Effect of Methylene Chloride on Respiration and Electron Transport System (ETS) Activity in Freshwater Sediment,
W85-04475 5C

METROPOLITAN WATER MANAGEMENT
Empirical Basis for Municipal Water Rates Modification,
W85-04688 3D

MICHIGAN
Low-Head Hydropower for Local Use,
W85-04620 6B

Protozoan Colonization Rates and Trophic Status of Some Freshwater Wetland Lakes,
W85-04657 2H

MICRO LAYERS
Small-scale Temporal Changes in the Biological and Chemical Composition of Surface Microlayers in a Eutrophic Lake,
W85-04538 2H

MICROCYSTIS
Specific Ultraviolet Absorbance Band of Microcystis aeruginosa Toxins,
W85-04816 5A

MICROELEMENTS
Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

MICROORGANISMS
Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies,
W85-04435 5C

Quantitative Estimation in COD Units of Refractory Organic Compounds Produced by Activated Sludge Microorganisms,
W85-04486 5D

Phosphatases and Their Role in Organic Phosphorus Transformation in Natural Waters. A Review,
W85-04613 2K

Determination of Microbial Cell Numbers in Subsurface Samples,
W85-04636 5A

Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

Bioturbation and Microbial Activity,
W85-04704 2L

Microbial Heterotrophic Activity Assessment in a Waste-water Treatment System,
W85-04706 5D

Radiotracer Estimation of Microbial Biomass in Lake Sediment,
W85-04848 2H

MICROWAVES
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

MIDGES
Monitoring of River Water Quality within the Great Ouse Basin Using the Chironomid Exuvial Analysis Technique,
W85-04454 5A

Acute Toxicity of Copper to Three Life Stages of Chironomus tentans as Affected by Water Hardness-Alkalinity,
W85-04946 5C

MINE DRAINAGE
Treatment of Ferruginous Ground Water from an Abandoned Colliery,
W85-04596 5D

Chemical Flocculation for Suspended Solids Removal at Remote Mine Sites,
W85-04730 5D

MINE WASTES
Attenuation of Chemical Elements in Acidic Leachates from Coal Mineral Wastes by Soils,
W85-04600 5B

Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

Vascular Riffle Flora of Appalachian Streams: The Ecology and Effects of Acid Mine Drainage on Justicia americana (L.) Vahl,
W85-04884 5C

Comparative Survey of the Erpobdella octoculata (L.) Populations in the Afon Crafnant, N. Wales, Above and Below an Input of Zinc from Mine-Waste,
W85-04886 5C

MINERALIZATION
Arsenic Speciation in Soil-Pore Waters From Mineralized and Unmineralized Areas of South-West England,
W85-04662 2K

MINERALS
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

MINNESOTA
Assessment of Historical Change in Two Northern Minnesota Lakes,
W85-04602 5B

MISSISSIPPI RIVER DELTA
Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

MISSOURI RIVER
Garrison Diversion Unit - An Update,
W85-04574 4A

MITCHELL CREEK
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

MIXING
Vertical Mixing in Amazon Floodplain Lakes,
W85-04569 2H

MOBILE BED FILTRATION
Optimization of Sand Recycle Rate in Mobile Bed Filtration,
W85-04663 5F

MODEL STUDIES
Modelling Eutrophication in Shallow Dutch Lakes,
W85-04551 5C

Interflow Model: II. Model Validation,
W85-04579 2A

Sensitivity Analysis of Reservoir Oxygen Model,
W85-04585 2H

Dispersion Modeling of Multiple Sources Using the HP-41CV,
W85-04644 5B

Thermal Mortality Prediction Equations for Entrainable Striped Bass,
W85-04682 5C

Proposed Framework for Developing a Multidisciplinary Wetlands Valuation Model,
W85-04684 2L

Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

Sediment Detention Pond Model Using CSTRS Mixing Theory,
W85-04731 5E

Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

Hydraulic Modelling at the Piedra del Aguila Dam,
W85-04781 8B

Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; 2. Numerical Simulation,
W85-04788 5B

Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry,
W85-04792 5C

Stochastic Modeling of Groundwater Flow by Unconditional and Conditional Probabilities: The Inverse Problem,
W85-04793 2F

Statistical Inference for Point Process Models of Rainfall,
W85-04794 2B

Physical Model of the Aquatic Ecosystem,
W85-04850 2H

Computing Degradation and Local Scour,
W85-04934 2J

Unified Analysis of Thickening,
W85-04964 5E

Time Series Models for Treatment of Surface Waters,
W85-04965 5F

MODULUS OF ELASTICITY
Parker Dam Concrete Core Investigations,
W85-04935 8F

MOLLUSKS
Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

Bioturbation and Microbial Activity,
W85-04704 2L

Tolerance to and Uptake of Lead in the Green Mussel, Perna viridis (L.),
W85-04708 5C

Human Modification of Molluscan Habitats in Little Creek Estuary, Virginia,
W85-04859 6G

MONITORING
Monitoring of River Water Quality within the Great Ouse Basin Using the Chironomid Exuvial Analysis Technique,
W85-04454 5A

Determination of Polyaromatic Hydrocarbons in Scallops (Pecten maximus) by UV Fluorescence and HPLC Combined with UV and Fluorescence Detectors,
W85-04474 5B

Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

Sewage-Derived Bacteria Monitored in a Marine Water Column by Means of Captive Mussels,
W85-04868 5A

1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures,
W85-04928 7B

MONT BLANC
Atmospheric Heavy Metals in High Altitude Surface Snows From Mont Blanc, French Alps,
W85-04501 5B

MORTALITY
Thermal Mortality Prediction Equations for Entrainable Striped Bass,
W85-04682 5C

Gas Supersaturation as a Cause of Early Spring Mortality of Stocked Trout,
W85-04844 2H

MOSQUITOS
T2-Coliphage Uptake By Mosquito Larvae,
W85-04493 5D

MOVING COORDINATE SYSTEMS
Evaluation of a Moving-Co-ordinate System Model of Salinity Intrusion into the Mersey Estuary,
W85-04528 2L

MUD FLATS
Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

MUD-WATER INTERFACES
Sediment Composition, Mud-water Interchanges and the Role of Macrophytes in Dal Lake, Kashmir,
W85-04904 2H

MULTIPURPOSE PROJECTS
Cost Sharing in a Multipurpose Water Project,
W85-04778 6C

MUNICIPAL WASTEWATER
Some Aspects of the Use of Oxidation Techniques in the Treatment of Sewage,
W85-04822 5D

MUNICIPAL WATER
Empirical Basis for Municipal Water Rates Modification,
W85-04688 3D

MUSSELS
Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

Role of Bivalves in the Phosphorus and Nitrogen Budget in Lakes,
W85-04558 2H

Tolerance to and Uptake of Lead in the Green Mussel, Perna viridis (L.),
W85-04708 5C

Sewage-Derived Bacteria Monitored in a Marine Water Column by Means of Captive Mussels,
W85-04868 5A

Trace Metal and PCB Content of Mussels (Mytilus edulis) from the Southwestern Baltic Sea,
W85-04902 5B

NAPHTHALENE
Simultaneous Accumulations of Naphthalene, a PCB Mixture, and Benzo(a)pyrene, by the Oyster, Crassostrea virginica,
W85-04477 5B

NEBRASKA
Ground-Water Contamination and Well Construction in Southeast Nebraska,
W85-04637 5B

NER RIVER
Phosphorus, Nitrogen, and Carbon Cycling by Fish Populations in Two Small Lowland Rivers in Poland,
W85-04888 5B

NETHERLANDS
Industrial Effluent Control in the Netherlands and Legislation in this Field in Some Other European Countries,
W85-04520 5G

Loosdrecht Lakes Restoration Project, an Introduction,
W85-04544 2H

Loosdrecht Lakes Restoration Project: Hydrology and Physico-Chemical Characteristics of the Lakes,
W85-04545 2H

Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

Seston-Epipelon Interrelationships in the Shallow Eutrophic Loosdrecht Lakes (The Netherlands),
W85-04547 2H

Zooplankton and its Grazing as Measures of Trophy in the Loosdrecht Lakes,
W85-04548 2H

Macrophytes in the Loosdrecht Lakes: A Story of Their Decline in the Course of Eutrophication,
W85-04549 5C

Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

Modelling Eutrophication in Shallow Dutch Lakes,
W85-04551 5C

Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

Carbon Mineralization in Microaerobic and Anaerobic Strata of Lake Vechten (The Netherlands): Diffusion Flux Calculations and Sedimentation Measurements,
W85-04702 2H

Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

NEUTRON ACTIVATION ANALYSIS
Dithiocarbamate Extraction of Gallium from Natural Waters and from Biological Samples for Neutron Activation Analysis,
W85-04961 5A

NEVADA
Rangeland Erosion Measurements for the USLE,
W85-04728 2J

NEW HAMPSHIRE
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

NEW JERSEY
Pedologic Properties of New Jersey Tidal Marshes,
W85-04955 2L

NEW SOUTH WALES
Management of Sediment in New South Wales, Australia,
W85-04444 4D

NEW YORK
Nitrogen-Isotope Ratios of Nitrate in Ground Water Under Fertilized Fields, Long Island, New York,
W85-04641 5B

Environmental Impact of Two, Adjacent, Hazardous Waste Disposal Sites in the Niagara River Watershed,
W85-04718 5C

Nitrate Contamination: Public Awareness,
W85-04828 5F

NEW YORK BIGHT
Sediment Budget Study of Clamshell Dredging and Ocean Disposal Activities in the New York Bight,
W85-04598 6G

NEW ZEALAND
Sedimentation in New Zealand Hydroelectric Schemes,
W85-04445 2J

Preliminary Investigation on Effects of Fluctuating Flows on Invertebrates of the Hawea River, a Large Regulated River in New Zealand,
W85-04668 2H

Trends in Lake Rotorua Water Quality,
W85-04669 2H

Factors Affecting Clarity of New Zealand Lakes,
W85-04670 2H

Macroinvertebrates in a Sewage-Polluted Aquifer,
W85-04720 5C

Analysis of Changes in the Invertebrate Community Along a Southern New Zealand Montane Stream,
W85-04724 2H

Effect of Effluent High in Chromium on Marine Sediment Aerobic Heterotrophic Bacteria,
W85-04869 5C

NIAGARA FALLS
Environmental Impact of Two, Adjacent, Hazardous Waste Disposal Sites in the Niagara River Watershed,
W85-04718 5C

NIAGARA RIVER
Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

Environmental Impact of Two, Adjacent, Hazardous Waste Disposal Sites in the Niagara River Watershed,
W85-04718 5C

NIGERIA
Comparative Studies of NO3- Concentrations in Some Tropical Rains,
W85-04506 5B

NIPIGON LAKE
Aquatic Macrophyte Vegetation of an Isolated Island Lake Adjacent to Lake Nipigon, Ontario: A Comparative Study After a Fifty-six Year Interval,
W85-04661 2H

NITRATES
Comparative Studies of NO3- Concentrations in Some Tropical Rains,
W85-04506 5B

Groundwater Source of Nitrate in Nearshore Marine Sediments,
W85-04616 5B

Nitrogen-Isotope Ratios of Nitrate in Ground Water Under Fertilized Fields, Long Island, New York,
W85-04641 5B

Nitrate Contamination: Public Awareness,
W85-04828 5F

Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

NITRIFICATION
Pilot-Plant Evaluation of a Deep Shaft Linked to Conventional Aeration Without Inter-Stage Settlement to Give a Fully-Nitrified Effluent,
W85-04452 5D

NITROGEN
Experimental Lake Fertilization: Turnover of Nitrogen and Phosphorus in Stratified and Non-Stratified Subarctic Lakes in Northern Sweden,
W85-04534 2H

Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

Changes of Organic and Inorganic Nitrogen in a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Organische en Anorganische Stikstof van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04890 5G

Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04899 5A

Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

Nitrogenous Wastewater Treatment by Activated Algae,
W85-04967 5D

NITROGEN ISOTOPES
Nitrogen-Isotope Ratios of Nitrate in Ground Water Under Fertilized Fields, Long Island, New York,
W85-04641 5B

NITROGEN REMOVAL
Eutrophication Control and the Fallacy of Nitrogen Removal,
W85-04774 5G

NKULA FALLS
Malawi - Driving a 9 m Diameter Power Conduit with Low Cover at Nkula Falls,
W85-04819 8A

NOISE CORRELATION
Recent Developments in Leak Noise Correlation Techniques,
W85-04958 8G

NONIONIC SURFACTANTS
Biodegradability of Two Primary Alcohol Ethoxylate Nonionic Surfactants Under Practical Conditions, and the Toxicity of the Biodegradation Products to Rainbow Trout,
W85-04487 5D

NONPOINT POLLUTION SOURCES
Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

NORFOLK
Rainborne SO2, Precipitation pH and Airborne SO2 Over Short Sampling Times Throughout Individual Events,
W85-04500 5B

NORFOLK BROADS
Large-Scale Field Experiment in the Control of Eutrophication in the Norfolk Broads,
W85-04465 5G

NORTH AMERICAN
Spatial Distributions of Precipitation Acidity and Major Ion Wet Deposition in North America During 1980,
W85-04647 5B

NORTH CAROLINA
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

NORTH DAKOTA
Garrison Diversion Unit - An Update,
W85-04574 4A

NORWAY
Conceptual Model of Lake Acidification,
W85-04531 5C

Changes in Base Cation Concentrations Due to Freshwater Acidification,
W85-04532 5C

Concentrations of Seabirds Along the Face of Glaciers and Outlets of Rivers in Svalbard (Konsentrasjoner av sjofugl langs kanten av isbreer og ut-lofor breelver pa Svalbard),
W85-04608 2L

Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

NOVA SCOTIA
Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

NUCLEAR EXPLOSIONS
Water Utility in the Nuclear Age,
W85-04773 5B

NUCLEAR POWERPLANTS
Radioecological Studies of Activation Products Released from a Nuclear Power Plant into the Marine Environment,
W85-04865 5B

NUTRIENT LOAD
Impact of Nutrient Load on Total Biomass and Species Succession in Lake Suwa, Japan,
W85-04565 5C

NUTRIENT REMOVAL
Nutrient Removal Trials and Bioassay Evaluation at Budds Farm Sewage-Treatment Works, Havant,
W85-04526 5D

A/O Process - Biological Treatment with Nutrient Removal,
W85-04594 5D

NUTRIENTS
Phytoplankton in a Polluted Subarctic Lake Before and After Nutrient Reduction,
W85-04490 5C

Seston-Epipelon Interrelationships in the Shallow Eutrophic Loosdrecht Lakes (The Netherlands),
W85-04547 2H

Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

Stream Phosphorus Exports from Prealpine Watersheds with Respect to Geology and Land Use,
W85-04560 5B

Nutrient Processing in Amazon Floodplain Lakes,
W85-04571 2K

Inorganic Nutrients Occurring in the Oxygen-deficient Bottom Water of Osaka Bay,
W85-04606 2K

Measurement and Comparative Values of the Short Circuit Metabolism (SCM) of Lakes by POC Relationship of Primary Production of Phytoplankton and Settling Matter,
W85-04701 2H

Carbon Mineralization in Microaerobic and Anaerobic Strata of Lake Vechten (The Netherlands): Diffusion Flux Calculations and Sedimentation Measurements,
W85-04702 2H

Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 2. Nutrient Salts,
W85-04711 5C

Seasonal Variation of Nutrient Limitation in Western Lake Erie,
W85-04719 2H

Determination of Spreading of Nutritive Salts in Quasi-Stagnant Waters by Using Lithium (Chloride) as Tracer and Continuous Measurement of Water-Quality Parameters (Die Bestimmung von Ausbreitungsvorgangen von Nahrsalzen in quasi stehenden Gewassern unter Verwendung des Tracers Lithium (Chlorid) und die kontinuierliche Messung von Wasserguteparametern),
W85-04810 5A

Nutrient Budgets for Agricultural Watersheds in the Southeastern Coastal Plain,
W85-04826 6G

Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

Experimental Lake Fertilization in the Knokkel Area, Northern Sweden. Phytoplankton Biomass and Algal Composition in Natural and Fertilized Subarctic Lakes,
W85-04910 2H

OCEAN DUMPING
Sediment Budget Study of Clamshell Dredging and Ocean Disposal Activities in the New York Bight,
W85-04598 6G

OCEANS
Let the Seas Do the Disposal,
W85-04648 5E

OCHLOCKONEE BAY
Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

ODOR CONTROL
Oxygen Injection Cuts Odors,
W85-04652 5D

Controlling Sewage Treatment Plant Odours,
W85-04769 5D

OIL
Revolutionary Experiments Turn Sludge into Fuel,
W85-04771 5E

OIL INDUSTRY
Status Report on Abatement of Water Pollution from the Canadian Petroleum Refining Industry - 1980.
W85-04940 5D

OIL POLLUTION
Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

OIL SHALE
Wastewater Treatment Systems for Synthetic Fuels Plants Based on Peat and Oil Shale,
W85-04880 5D

OIL SPILLS
Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

OIL WASTES
Status Report on Abatement of Water Pollution from the Canadian Petroleum Refining Industry - 1980.
W85-04940 5D

OLIGOCHAETES
Comparative Study of Respiration Rates of Some Aquatic Oligochaetes in Relation to Sublethal Stress,
W85-04905 5C

ONTARIO
River Basin Planning: Problems, Opportunities and Implications for Ontario Conservation Authorities,
W85-04572 6A

Rainfall Interception on a Small Forested Watershed within the Kawartha Lakes Region,
W85-04578 2I

Effects of Land Drainage on Stream Flow,
W85-04583 4C

Small Format, Hand Held Helicopter Based Photography for Monitoring Industrial Water Effluent Plumes,
W85-04586 7B

Floodplain Policy and Practice in the Credit River Watershed, Ontario,
W85-04587 6F

Aquatic Macrophyte Vegetation of an Isolated Island Lake Adjacent to Lake Nipigon, Ontario: A Comparative Study After a Fifty-six Year Interval,
W85-04661 2H

Empirical Basis for Municipal Water Rates Modification,
W85-04688 3D

Managing Summer Lawn Irrigation Demands: A Water Use Index,
W85-04694 3D

Lawn and Garden Watering Regulations: Conservation Through a Water Use Index,
W85-04695 3D

Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides,
W85-04757 5B

Modelling Winter Oxygen Depletion Rates in Ice-Covered Temperate Zone Lakes in Canada,
W85-04843 2H

OPACITY
Factors Affecting Clarity of New Zealand Lakes,
W85-04670 2H

OPEN CHANNEL FLOW
Fundamental Differential Equation of Flow of a Fluid with a Variable Mass in the Case of Bilateral Water Diversion,
W85-04428 2E

OPENCAST RESIDUAL LAKES
Qualitative and Quantitative Entomofaunistic Investigation of an Opencast Residual Lake near Leipzig (GDR),
W85-04906 2H

OPERATING POLICIES
Experience in the Operation of Hydraulic Structures and Equipment of Hydroelectric Stations,
W85-04423 8C

OPTICAL PROPERTIES
Factors Affecting Clarity of New Zealand Lakes,
W85-04670 2H

Near Bottom Variations of Turbidity in the St. Lawrence Estuary,
W85-04677 2L

OPTIMIZATION
Optimization of Design Parameters of Complex Surge Tanks,
W85-04426 8A

Optimization of Coleshill Activated-Sludge Plant Operating Conditions,
W85-04590 5D

ORGANIC CARBON
Dissolved Organic Carbon in Danish Lakes: Concentration, Composition, and Lability,
W85-04540 5C

Effects of Dissolved Organic Carbon on the Adsorption Properties of Plutonium in Natural Waters,
W85-04799 5B

ORGANIC COMPOUNDS
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

Subchronic Effects of a Mixture of 'Persistent' Chemicals Found in the Great Lakes,
W85-04479 5C

Quantitative Estimation in COD Units of Refractory Organic Compounds Produced by Activated Sludge Microorganisms,
W85-04486 5D

Organic Acidity in Precipitation of North America,
W85-04499 5B

Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

Migration and Attenuation of Selected Organics in a Sandy Aquifer - A Natural Gradient Experiment,
W85-04635 5B

Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; I. Equation Development,
W85-04787 5B

Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; 2. Numerical Simulation,
W85-04788 5B

Biodegradation of Organic Chemicals,
W85-04797 5B

Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance,
W85-04907 2L

Capillary Gas Chromatography Determination of Volatile Organic Acids in Rain and Fog Samples,
W85-04959 5A

ORGANIC LOAD
Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

ORGANIC MATTER
Measurement and Comparative Values of the Short Circuit Metabolism (SCM) of Lakes by POC Relationship of Primary Production of Phytoplankton and Settling Matter,
W85-04701 2H

ORGANOCHLORINE PESTICIDES
Organochlorine Residues in Common Terns and Associated Estuarine Organisms, Massachusetts, USA, 1971-81,
W85-04861 5B

ORTHOPHOSPHATES
Model of Diatom Dynamics in the Epilimnion of Lake Jezero on the Island of Krk,
W85-04900 2H

Effects of Ecological Perturbations on Diatom Dynamics in the Model of Lake Jezero,
W85-04901 2H

OSAKA BAY
Inorganic Nutrients Occurring in the Oxygen-deficient Bottom Water of Osaka Bay,
W85-04606 2K

OUTFALLS
Let the Seas Do the Disposal,
W85-04648 5E

OXIDANTS
Controlling Sewage Treatment Plant Odours,
W85-04769 5D

OXIDATION
Decreasing Rate of Biochemical Oxidation of Sewage,
W85-04468 5D

Effect of Ionic Interactions on the Oxidation of Metals in Natural Waters,
W85-04761 2K

Some Aspects of the Use of Oxidation Techniques in the Treatment of Sewage,
W85-04822 5D

Oxidation of Cyanides in Industrial Wastewaters by Ozone,
W85-04881 5D

OXYGEN
Short-term Effects of Liming on Sediment Oxygen Uptake in an Acid lake,
W85-04537 5G

Oxygen Injection Cuts Odors,
W85-04652 5D

Pure O2 Retrofit Doubles Plant's Capacity,
W85-04953 5D

OXYGEN DEPLETION
Modelling Winter Oxygen Depletion Rates in Ice-Covered Temperate Zone Lakes in Canada,
W85-04843 2H

OXYGEN FLUX
Relationships among Oxygen Flux, Soil Water Tension, and Aeration Porosity in a Drying Soil Profile,
W85-04956 2G

OXYGENATION
Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions),
W85-04559 5G

OYSTERS
Simultaneous Accumulations of Naphthalene, a PCB Mixture, and Benzo(a)pyrene, by the Oyster, Crassostrea virginica,
W85-04477 5B

Oyster Reefs as Processors of Estuarine Materials,
W85-04483 2L

Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

Trace Metal-Binding Proteins in Marine Molluscs and Crustaceans,
W85-04873 5C

OZONATION
Oxidation of Cyanides in Industrial Wastewaters by Ozone,
W85-04881 5D

PALEOLIMNOLOGY
Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

PANAMA
Controlling Erosion and Sedimentation in the Panama Canal Watershed,
W85-04442 4D

PARASITES
Destruction of Pathogens and Parasites in Sewage Sludge by Chemical Means,
W85-04592 5E

PARTICLE SIZE
Coarse Fraction of Soils: The Role it Plays in Plant Nutrition, Liming and Irrigation,
W85-04823 2G

Influence of Suspended Particle Size Distribution in Deep-Bed Filtration,
W85-04876 5F

PARTICULATE MATTER
Voltammetric Methods for Distinguishing between Dissolved and Particulate Metal Ion Concentrations in the Presence of Hydrous Oxides. A Case Study on Lead (II),
W85-04800 5A

PARTICULATES
Measurement of Particulate Association of Americium in Freshwater,
W85-04491 5A

PATH OF POLLUTANTS
Geochemistry of Inorganic Germanium In Natural Waters,
W85-04482 2K

Analysis of Precipitation Collected on a Sequential Basis,
W85-04505 5B

Small Format, Hand Held Helicopter Based Photography for Monitoring Industrial Water Effluent Plumes,
W85-04586 7B

Physical Processes and Pollution in the Waters of Spencer Gulf,
W85-04763 2L

Regional Variation in the Distribution of Trace Metals in Modern Intertidal Sediments of Northern Spencer Gulf, South Australia,
W85-04764 5B

PATHOGENIC BACTERIA
Destruction of Pathogens and Parasites in Sewage Sludge by Chemical Means,
W85-04592 5E

PEAT
Wastewater Treatment Systems for Synthetic Fuels Plants Based on Peat and Oil Shale,
W85-04880 5D

PEBBLELOGGITCH LAKE
Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

PELAGIC LIFE
Benthic-Pelagic Coupling in Sewage-Affected Marine Ecosystems,
W85-04874 5C

PENNSYLVANIA
Effect of Agricultural Land Use on Ground-Water Quality in a Small Pennsylvania Watershed,
W85-04642 5B

PERCOLATION BASINS
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

PERFORMANCE INDICATORS
Use of Performance Indicators in Sewage Treatment Appraisal,
W85-04510 5D

PERIPHYTON
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

Short-Term Uptake of Heavy Metals by Periphyton Algae,
W85-04721 5B

Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

PERIWINKLES
Embryo Abnormalities in the Periwinkle, Littorina 'saxatilis', as Indicators of Stress in Polluted Marine Environments,
W85-04893 5A

PERMEABILITY COEFFICIENT
Hydraulic Conductivity Measured Electronically in an Auger Hole,
W85-04740 2G

Field Method to Determine Unsaturated Hydraulic Conductivity Using Flow Nets,
W85-04791 2G

PERMEATION SAMPLERS
Use of a Permeation Sampler for Determination of Volatile Priority Pollutants,
W85-04960 5A

PERMETHRIN
Dissipation of Permethrin in Limnocorrals,
W85-04838 5B

PERU
Cost Sharing in a Multipurpose Water Project,
W85-04778 6C

Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

PESTICIDE RESIDUES
Organochlorine Residues in Common Terns and Associated Estuarine Organisms, Massachusetts, USA, 1971-81,
W85-04861 5B

PESTICIDE TOXICITY
Alachlor Toxicity to a Freshwater Teleost Clarias batrachus,
W85-04885 5C

Aquatic Toxicity of 2,6-Dichlorobenzamide (BAM), a Degradation Product of the Herbicide Dichlobenil,
W85-04944 5C

PFORZHEIM
'Rennfeld' Small-Scale Hydroelectric Power Plant Near Pforzheim (Kleinwasserkraftanlage 'Rennfeld' bei Pforzheim),
W85-04629 8A

PHOSPHATASES
Phosphatases and Their Role in Organic Phosphorus Transformation in Natural Waters. A Review,
W85-04613 2K

PHOSPHATES
Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions,
W85-04498 5F

Availability to Plants of Phosphate in Sludges Precipitated from the Effluent from Sewage Treatment,
W85-04597 5E

Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

PHOSPHORUS
Experimental Lake Fertilization: Turnover of Nitrogen and Phosphorus in Stratified and Non-Stratified Subarctic Lakes in Northern Sweden,
W85-04534 2H

Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

Impact of Sedimentation on the Phosphorus Content of the Euphotic Zone of Lake Constance,
W85-04555 2H

External and Internal Loading and Retention of Phosphorus in the R. Jorka Lakes (Masurian Lakeland, Poland) vs Their Trophic Status,
W85-04556 2H

Stream Phosphorus Exports from Prealpine Watersheds with Respect to Geology and Land Use,
W85-04560 5B

Availability of Sediment P in Lake Lugano,
W85-04563 2H

Predicting the Effect of Macrobenthos on the Sediment/Water Flux of Metals and Phosphorus,
W85-04839 2K

Cellular Phosphorus Concentration as a Criterion for Trophic Status in Rapidly Flushed Lakes,
W85-04846 2H

Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04898 5A

PHOSPHORUS COMPOUNDS
Phosphorus in the Bottom Sediments of Some Lakes of the World,
W85-04612 2H

Phosphatases and Their Role in Organic Phosphorus Transformation in Natural Waters. A Review,
W85-04613 2K

PHOSPHORUS LOADING
Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

PHOSPHORUS REMOVAL
Need for Chemical Phosphate Removal,
W85-04821 5D

PHYSICOCHEMICAL PROPERTIES
Influence of Water Hyacinth Cover on the Physico-Chemical Characteristics of Water and Phytoplankton Composition in a Reservoir near Jaipur (India),
W85-04913 5C

PHYTOPLANKTON
Phytoplankton Production in the Corpus Christi Bay Estuary,
W85-04432 2L

Phytoplankton in a Polluted Subarctic Lake Before and After Nutrient Reduction,
W85-04490 5C

Phytoplankton in 151 Eastern Finnish Lakes: Species Composition and its Relations to the Water Chemistry,
W85-04543 2H

Phytoplankton as Biological Parameter for the Trophic Characterization of Lakes,
W85-04561 2H

Comparison of the Selenastrum Bottle Test and the Natural Phytoplankton Assay in Algal Toxicity Tests,
W85-04615 5A

Measurement and Comparative Values of the Short Circuit Metabolism (SCM) of Lakes by POC Relationship of Primary Production of Phytoplankton and Settling Matter,
W85-04701 2H

Phytoplankton Responses to Reduction and Elimination of Submerged Vegetation by Herbicides and Grass Carp in Four Florida Lakes,
W85-04857 5G

PCB Resistance within Phytoplankton Populations in Polluted and Unpolluted Marine Environments,
W85-04864 5C

Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

Experimental Lake Fertilization in the Kuokkel Area, Northern Sweden. Phytoplankton Biomass and Algal Composition in Natural and Fertilized Subarctic Lakes,
W85-04910 2H

Influence of Water Hyacinth Cover on the Physico-Chemical Characteristics of Water and Phytoplankton Composition in a Reservoir near Jaipur (India),
W85-04913 5C

PICLORAM
Gas Chromatographic Determination of Picloram in Fish,
W85-04433 5A

PIEDRA DEL AGUILA DAM
Hydraulic Modelling at the Piedra del Aguila Dam,
W85-04781 8B

PINE TREES
Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

PIPELINES
Recent Developments in Leak Noise Correlation Techniques,
W85-04958 8G

Leaching of Tetrachloroethylene from Vinyl-Lined Pipe,
W85-04963 5F

PITT COUNTY
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

PLANKTON
Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

Studies on the Carbon Flux from Phyto- to Bacterioplankton Communities in Lake Constance,
W85-04672 2H

Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

Seasonal Variations in Four Bacterial Size Fractions from a Hypertrophic Pond in Tokyo, Japan,
W85-04912 2H

PLANNING
Role of Watershed Management in Water Resources Development Planning - Need for Integrated Approach to Development of Catchment and Command of Irrigation Projects,
W85-04441 6B

River Basin Planning: Problems, Opportunities and Implications for Ontario Conservation Authorities,
W85-04572 6A

Apples and Oranges: Toward a Critique of Public Participation in Great Lakes Decisions,
W85-04573 6A

Integrated Planning System for Hydro Development in Ecuador,
W85-04780 6A

Mathematical Model for Reservoir Sedimentation Planning,
W85-04785 6A

Theory of Fuzzy Subsets and Its Applications to Water-Resources Planning (Die Theorie unscharfer Teilmengen und ihre Anwendung in der Wasserwirtschaft),
W85-04806 6A

PLANT COMMUNITIES
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

PLANT GROWTH
Sensitivity of Stone Fruit Rootstocks to Waterlogging,
W85-04812 2I

Effects of a Textile Factory Effluent on Soil and Crop Plants,
W85-04945 5D

PLANT NUTRITION
Coarse Fraction of Soils: The Role it Plays in Plant Nutrition, Liming and Irrigation,
W85-04823 2G

PLANT WATER POTENTIALS
Water Relations of Jamaican Upper Montane Rain Forest Trees,
W85-04824 2I

PLANTS
Availability to Plants of Phosphate in Sludges Precipitated from the Effluent from Sewage Treatment,
W85-04597 5E

PLASTICIZERS
Determination of Trialkyl and Triaryl Phosphates in Environmental Samples,
W85-04497 5B

PLINTHITE
Movement of Water in a Plinthic Paleudult Using a Bromide Tracer,
W85-04957 2G

PLON
Methanogenesis in Sediments of Eutrophic Lakes; 2. Comparative Investigations on the Methane-Precursor Preference,
W85-04554 2H

PLUMES
Small Format, Hand Held Helicopter Based Photography for Monitoring Industrial Water Effluent Plumes,
W85-04586 7B

Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

PLUSSSEE
Distribution, Dynamic and Structure of Free Dissolved Carbohydrates in the Plussee, a North German Eutrophic Lake,
W85-04552 2H

PLUTONIUM
Effects of Dissolved Organic Carbon on the Adsorption Properties of Plutonium in Natural Waters,
W85-04799 5B

POISSON RATIO
Parker Dam Concrete Core Investigations,
W85-04935 8F

POLAND
External and Internal Loading and Retention of Phosphorus in the R. Jorka Lakes (Masurian Lakeland, Poland) vs Their Trophio Status,
W85-04556 2H

Outdoor Recreation - A New Factor Disturbing Lake Ecosystems, as Exemplified by Lake Gim, Mazurian Lake District,
W85-04557 5C

Effect of Anthropogenous Changes of Water Conditions on the Vegetation in the Forest Reserve Las Bielanski in Warsaw (Wplyw antropogennych zmian stosunkow wodnych na roslinnosc rezerwatu Las Bielanski w Warszawie),
W85-04610 4C

Snow Pollution and Its Effect on Heavy Metals Load of the Kozlowa Gora Reservoir as Compared to Rain and River Water,
W85-04611 5B

Typhetum angustifoliae and Typhetum latifoliae as Indicators of Various Habitats,
W85-04614 2L

Wastewater Disposal and Utilization in Agriculture in Poland and Hungary,
W85-04664 5E

Phosphorus, Nitrogen, and Carbon Cycling by Fish Populations in Two Small Lowland Rivers in Poland,
W85-04888 5B

POLAROGRAPHY
Simultaneous Determination of Zinc and Chromate in Cooling Water by Differential Pulse Polarography,
W85-04624 5A

POLICY ASPECTS
Reservoir Sedimentation in India – Its Causes, Control, and Future Course of Action,
W85-04439 6G

POLIOVIRUS
Comparison of Current Methods of Poliovirus Concentration from Tap Water,
W85-04492 5F

POLLUTANT IDENTIFICATION
Gas Chromatographic Determination of Picloram in Fish,
W85-04433 5A

Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

Application of Ion-Exchange Chromatography with an Ion-Selective Electrode Detector to Iodine Determination in Natural Waters,
W85-04654 5A

Scheme for the Direct Analysis of Organics in the Environment by Tandem Mass Spectrometry,
W85-04656 5A

Capillary Gas Chromatography Determination of Volatile Organic Acids in Rain and Fog Samples,
W85-04959 5A

POLLUTION CONTROL
Methodology for Pollution Control Decision Analysis,
W85-04582 5G

POLYAROMATIC HYDROCARBONS
Determination of Polyaromatic Hydrocarbons in Scallops (Pecten maximus) by UV Fluorescence and HPLC Combined with UV and Fluorescence Detectors,
W85-04474 5B

POLYCHAETES
Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

Study of Domestic Sewage Waste Treatment by the Polychaetes, Neanthes japonica and Perinereis nuntia var. vallata, on an Artificial Tidal Flat,
W85-04903 5D

POLYCHLORINATED BIPHENYLS
Organochlorine Insecticides and PCBs in Water, Sediment, and Fish from the Mediterranean Sea,
W85-04473 5B

Simultaneous Accumulations of Naphthalene, a PCB Mixture, and Benzo(a)pyrene, by the Oyster, Crassostrea virginica,
W85-04477 5B

PCBs and Organochlorine Pesticides in the St. Lawrence System (BPC ET Pesticides Organochlores Dans Le Systeme Saint-Laurent),
W85-04581 5B

Review of the Food and Drug Administration Risk Analysis for Polychlorinated Biphenyls in Fish,
W85-04775 5C

Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Frisian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland),
W85-04808 5B

PCB Resistance within Phytoplankton Populations in Polluted and Unpolluted Marine Environments,
W85-04864 5C

Simultaneous Exposure of English Sole (Parophrys vetulus) to Sediment-Associated Xenobiotics: Part 1 - Uptake and Disposition of 14C-Polychlorinated Biphenyls and 3H-Benzo(a)Pyrene,
W85-04870 5C

Trace Metal and PCB Content of Mussels (Mytilus edulis) from the Southwestern Baltic Sea,
W85-04902 5B

POLYCYCLIC HYDROCARBONS
Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

POLYELECTROLYTES
Influence of the Charge Density of Cationic Polyelectrolytes on Sludge Conditioning,
W85-04494 5D

POLYNUCLEAR AROMATIC HYDROCARBONS
Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Frisian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland),
W85-04808 5B

PONDS
Changes in the Oxygen Balance of a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Zuurstofbalans van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04889 5G

Changes of Organic and Inorganic Nitrogen in a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Organische en Anorganische Stikstof van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04890 5G

POPULATION DYNAMICS
Zooplankton Dynamics in Lake Mendota: Short-term Versus Long-term Changes,
W85-04897 2H

Model of Diatom Dynamics in the Epilimnion of Lake Jezero on the Island of Krk,
W85-04900 2H

POROUS MEDIA
Galerkin Finite-Element Program for Simulating Unsaturated Flow in Porous Media,
W85-04645 2F

Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; I. Equation Development,
W85-04787 5B

Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; 2. Numerical Simulation,
W85-04788 5B

PORTUGAL
Investigation into the Hydraulic Resources of a Lagoon in Portugal,
W85-04461 5G

POTABLE WATER
Case Study, Potable Water Reservoir, Tuktoyaktuk, Northwest Territories,
W85-04927 6A

POTASSIUM PERMANGANATE
Controlling Sewage Treatment Plant Odours,
W85-04769 5D

POWER CONDUITS
Malawi - Driving a 9 m Diameter Power Conduit with Low Cover at Nkula Falls,
W85-04819 8A

POWERPLANT INTAKES
Factors Influencing Impingement of Fish by Lake Ontario Power Plants,
W85-04713 8I

POWERPLANTS
Manatee Use of Power Plant Effluents in Brevard County, Florida,
W85-04696 5C

Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

PRECIPITATION
Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions,
W85-04498 5F

Method for Estimating Precipitation Amounts at Remote Field Sites,
W85-04667 2B

Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures,
W85-04928 7B

PRECIPITATION CHEMISTRY
Organic Acidity in Precipitation of North America,
W85-04499 5B

Rainborne SO2, Precipitation pH and Airborne SO2 Over Short Sampling Times Throughout Individual Events,
W85-04500 5B

Atmospheric Heavy Metals in High Altitude Surface Snows From Mont Blanc, French Alps,
W85-04501 5B

Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

Composition of Precipitation on Amsterdam Island, Indian Ocean,
W85-04503 5B

Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

Analysis of Precipitation Collected on a Sequential Basis,
W85-04505 5B

Comparative Studies of NO3- Concentrations in Some Tropical Rains,
W85-04506 5B

PREDICTION
Note on the Prediction of Dissolved Oxygen Concentration in Estuaries,
W85-04529 2L

Prediction of Red Tide Occurrence by Means of Discriminant Analysis (in Japanese),
W85-04605 5C

PRESSURE
Pressure Rises Due to Unsteady Flow, Especially in High-Lift Navigation Locks (Druckerhohungen aufgrund instationarer Stromungsvorgange, insbesondere in Schiffsschleusen mit grossen Stufenhohen),
W85-04631 8B

PRICING
Role of Pricing in Managing the Demand for Water,
W85-04686 6A

Peak Use Charge: An Equitable Approach to Charging for and/or Reducing Summer Peak Use,
W85-04687 6C

Empirical Basis for Municipal Water Rates Modification,
W85-04688 3D

PRIMARY PRODUCTION
Vegetation and Primary Production in a Floating Freshwater Marsh in Louisiana,
W85-04855 2L

PRIMARY PRODUCTIVITY
Phytoplankton Production in the Corpus Christi Bay Estuary,
W85-04432 2L

Primary Production and Diuranal Variation in a Tropical Fish Pond,
W85-04852 5C

PRIORITY POLLUTANTS
Use of a Permeation Sampler for Determination of Volatile Priority Pollutants,
W85-04960 5A

PRIVATIZATION
Privatization Needs the Professional Approach,
W85-04954 6A

PROTOZOA
Protozoan Colonization Rates and Trophic Status of Some Freshwater Wetland Lakes,
W85-04657 2H

PUBLIC HEALTH
Maintenance of Drinking Water Quality: The Essential Decisions,
W85-04449 5F

Health and Amenity Aspects of Surface Waters,
W85-04457 5G

Waterborne Outbreak of Hepatitis A in Meade County, Kentucky,
W85-04658 5C

Review of the Food and Drug Administration Risk Analysis for Polychlorinated Biphenyls in Fish,
W85-04775 5C

Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

Giardia Lamblia and Water Supply,
W85-04829 5F

Causes of a Waterborne Giardiasis Outbreak,
W85-04830 5F

PUBLIC PARTICIPATION
Apples and Oranges: Toward a Critique of Public Participation in Great Lakes Decisions,
W85-04573 6A

PUBLIC POLICY
Watershed Rehabilitation Program Related to the Management of River and Reservoir Sedimentation in Indonesia,
W85-04438 4D

Floodplain Policy and Practice in the Credit River Watershed, Ontario,
W85-04587 6F

Role of Pricing in Managing the Demand for Water,
W85-04686 6A

PUBLIC RELATIONS
Managing Summer Lawn Irrigation Demands: A Water Use Index,
W85-04694 3D

Lawn and Garden Watering Regulations: Conservation Through a Water Use Index,
W85-04695 3D

PULP WASTES
Comparison of the Selenastrum Bottle Test and the Natural Phytoplankton Assay in Algal Toxicity Tests,
W85-04615 5A

Basic Technology of the Pulp and Paper Industry and Its Environmental Protection Practices,
W85-04932 5D

PUMPING
Discontinuous Wave on Stretches of an Abrupt Expansion of a Canal,
W85-04424 8B

PURIFICATION
Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

PURIFICATION LAKES
Design and Operation of the Purification Lakes in the Ruhr Valley,
W85-04459 5G

QUALITY CONTROL
Use of Performance Indicators in Sewage Treatment Appraisal,
W85-04510 5D

1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures,
W85-04928 7B

QUEBEC
Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision

Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

RADIOACTIVE WASTES
Radioecological Studies of Activation Products Released from a Nuclear Power Plant into the Marine Environment,
W85-04865 5B

RADIONUCLIDES
Measurement of Particulate Association of Americium in Freshwater,
W85-04491 5A

RADIUM RADIOISOTOPES
Radium Variability Produced by Shelf-water Transport and Mixing in the Western Gulf of Mexico,
W85-04712 2K

RAIN
Snow Pollution and Its Effect on Heavy Metals Load of the Kozlowa Gora Reservoir as Compared to Rain and River Water,
W85-04611 5B

Prediction of Soil Erosion by Water and Wind for Various Fractions of Cover,
W85-04732 2J

Method of Measuring Aggregate Stability Under Waterdrop Impact,
W85-04733 2J

RAIN FORESTS
Water Relations of Jamaican Upper Montane Rain Forest Trees,
W85-04824 2I

RAINFALL
Rainfall Interception on a Small Forested Watershed within the Kawartha Lakes Region,
W85-04578 2I

Statistical Inference for Point Process Models of Rainfall,
W85-04794 2B

Estimating the Parameters of a Cube Root Normal Distribution from Reduced Sample Data,
W85-04796 2B

RAINFALL-RUNOFF RELATIONSHIPS
Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

RANGELAND
Rangeland Erosion Measurements for the USLE,
W85-04728 2J

RATE STRUCTURE
Effects of Electricity Rates and Rate Structures on Pump Irrigation: An Eastern Colorado Case Study,
W85-04752 3F

REACTION CURRENTS
Concentrations of Seabirds Along the Face of Glaciers and Outlets of Rivers in Svalbard (Konsentrasjoner av sjofugl langs kanten av isbreer og utenfor breelver pa Svalbard),
W85-04608 2L

RECREATION
Outdoor Recreation - A New Factor Disturbing Lake Ecosystems, as Exemplified by Lake Gim, Mazurian Lake District,
W85-04557 5C

Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality,
W85-04753 6B

RECYCLING
Control and Treatment Technology for the Metal Finishing Industry. Ion Exchange.
W85-04931 5D

Recovery of Spent Sulfuric Acid from Steel Pickling Operations.
W85-04933 5E

RED DEER RIVER
Trees Scars to Determine the Frequency and Stage of High Magnitude River Ice Drives and Jams, Red Deer, Alberta,
W85-04589 7B

RED SEA
Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 1. Environmental Conditions,
W85-04710 5C

Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 2. Nutrient Salts,
W85-04711 5C

RED TIDE
Prediction of Red Tide Occurrence by Means of Discriminant Analysis (in Japanese),
W85-04605 5C

REGIONAL DEVELOPMENT
Environmental Control and Regional Growth,
W85-04735 6G

REGULATIONS
Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies,
W85-04435 5C

Proposed Legal Framework for the Regulation of Drinking Water,
W85-04766 6E

Status Report on Abatement of Water Pollution from the Canadian Petroleum Refining Industry - 1980.
W85-04940 5D

REHABILITATION
Solving the Problem of Rehabilitating Decayed Sewer Systems,
W85-04768 8A

RELINING
Relining: The Feasibility of Inserting Pipe into Existing Sewers,
W85-04693 8A

REMOTE SENSING
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

RENOVATION
Present Techniques for 'In-Situ' Sewer Renovation,
W85-04518 8F

REPRODUCTION
Effects of Mercury on the Prosobranch Mollusc Crepidula fornicata: Acute Lethal Toxicity and Effects on Growth and Reproduction of Chronic Exposure,
W85-04867 5C

RESERVOIR OPERATION
Experience in Operating the Bratsk Reservoir,
W85-04429 4A

Algorithms for Optimizing Hydropower System Operation,
W85-04786 4A

RESERVOIR SEDIMENTATION
Private and Social Cost - Benefit Perspectives and a Case Application on Reservoir Sedimentation Management,
W85-04447 4D

RESERVOIR SILTING
Mathematical Model for Reservoir Sedimentation Planning,
W85-04785 6A

RESERVOIR STORAGE
Reservoir Storage Equation Experimentally Verified,
W85-04416 2E

RESERVOIRS
Watershed Rehabilitation Program Related to the Management of River and Reservoir Sedimentation in Indonesia,
W85-04438 4D

Reservoir Sedimentation in India -- Its Causes, Control, and Future Course of Action,
W85-04439 6G

Physical and Economic Impacts of Sedimentation on Fishing Activities; Nam Pong Basin, Northeast Thailand,
W85-04448 5C

Evaluation of Eutrophication Impact in Public Water Supply Reservoirs in East Anglia,
W85-04451 5C

Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

Sensitivity Analysis of Reservoir Oxygen Model,
W85-04585 2H

Temperature-Growth Rate Relationships of Aerobic Heterotrophic Bacteria Isolated from a Silt-laden Impoundment,
W85-04815 2H

Case Study, Potable Water Reservoir, Tuktoyaktuk, Northwest Territories,
W85-04927 6A

Water Quality of the Colorado River System: Historical Trends in Concentration Load, and Mass Fraction of Inorganic Solutes,
W85-04942 2E

RESIDENCE TIME
Residence Time in Stormwater Detention Basins,
W85-04968 5D

RESIDUE COVER
Prediction of Soil Erosion by Water and Wind for Various Fractions of Cover,
W85-04732 2J

RESPIRATION
Effect of Methylene Chloride on Respiration and Electron Transport System (ETS) Activity in Freshwater Sediment,
W85-04475 5C

Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

RESPIRATION RATE
Comparative Study of Respiration Rates of Some Aquatic Oligochaetes in Relation to Sub-lethal Stress,
W85-04905 5C

RESTORATION
Decommissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

REVIEWS
Research Related to Water Pollution Control in South Africa,
W85-04456 5D

Basic Technology of the Pulp and Paper Industry and Its Environmental Protection Practices,
W85-04932 5D

RHEOLOGY
Determination of Certain Rheological Characteristics of Concrete Mixes by Shear Testing,
W85-04425 8F

RHONE RIVER
Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

RISK FACTORS
Review of the Food and Drug Administration Risk Analysis for Polychlorinated Biphenyls in Fish,
W85-04775 5C

RISKS
Maintenance of Drinking Water Quality: The Essential Decisions,
W85-04449 5F

RIVER BASINS
River Basin Planning: Problems, Opportunities and Implications for Ontario Conservation Authorities,
W85-04572 6A

RIVER BEDS
Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

RIVER FROME
Biology of Brachycentrus subnubilus Curtis (Trichoptera) in the River Frome, Dorset,
W85-04887 2H

RIVER MANAGEMENT
Water Reclamation and River Management in the Tame Basin,
W85-04460 5G

RIVER SEDIMENTS
Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

ROCK ANCHORS
Investigation into the Failure of a Prestressed Rock Anchor,
W85-04952 8G

RUHR VALLEY
Design and Operation of the Purification Lakes in the Ruhr Valley,
W85-04459 5G

RUNOFF
Effects of Motorway Run-Off on the Ecology of Stream Algae,
W85-04466 5C

Regional River Sulfur Runoff,
W85-04481 5B

Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

Runoff and Sediment Transport Within and From Small Agricultural Watersheds,
W85-04734 2J

Decomissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

RURAL AREAS
Water for the Flats.
W85-04811 4A

SALINE GROUNDWATER
Irrigation Scheduling Under Saline High Water Tables,
W85-04744 3F

SALINE WATER
Saline Irrigation Water: Effects on Soil Chemical and Physical Properties,
W85-04618 3C

Water Quality of the Colorado River System: Historical Trends in Concentration Load, and Mass Fraction of Inorganic Solutes,
W85-04942 2E

SALINE WATER INTRUSION
Evaluation of a Moving-Co-ordinate System Model of Salinity Intrusion into the Mersey Estuary,
W85-04528 2L

SALMON
Content and Chemical Form of Mercury and Selenium in Lake Ontario Salmon and Trout,
W85-04717 5C

Survival of Eggs and Alevins of Atlantic Salmon (Salmo salar) in Relation to the Chemistry of Interstitial Water in Redds in Some Acidic Streams of Atlantic Canada,
W85-04845 5C

Responses of Sockeye Salmon (Oncorhynchus nerka) to Fertilization of British Columbia Coastal Lakes,
W85-04847 8I

SALMON RIVER
Species Richness in Streams of Different Size from the Same Drainage Basin,
W85-04665 2H

SALT MARSHES
Effects of Organic Pollutants on Methanogenesis, Sulfate Reduction and Carbon Dioxide Evolution in Salt Marsh Sediments,
W85-04872 5C

SALTS
Factors Influencing the Behaviour of De-Icing Salts in an Urban Flood Control Reservoir,
W85-04584 5B

SALZKAMMERGUT
Stream Phosphorus Exports from Prealpine Watersheds with Respect to Geology and Land Use,
W85-04560 5B

SAMPLING
Different Approach to Water Quality Sampling,
W85-04524 5A

Subsampling Program for the Estimation of Fish Impingement,
W85-04604 5C

Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

Quantification of Stream Drift,
W85-04842 2H

Retrieval of Material from the Surface Microlayer with Screen and Plate Samplers and its Implications for Partitioning of Material within the Microlayer,
W85-04895 5A

Use of a Permeation Sampler for Determination of Volatile Priority Pollutants,
W85-04960 5A

SAMPLING DEVICES
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

SAMPLING FREQUENCY
Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

SAND FILTERS
Removing Giardia Cysts with Slow Sand Filtration,
W85-04831 5F

SAND RECYCLING RATE
Optimization of Sand Recycle Rate in Mobile Bed Filtration,
W85-04663 5F

SANDY SOIL
Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
W85-04727 2D

SANTIAGO
Economic/Institutional Issues in Sedimentation Management in Developing Countries,
W85-04443 4D

SAUDI ARABIA
Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 2. Nutrient Salts,
W85-04711 5C

SAUDIA ARABIA
Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 1. Environmental Conditions,
W85-04710 5C

SAWYERS BAY
Effect of Effluent High in Chromium on Marine Sediment Aerobic Heterotrophic Bacteria,
W85-04869 5C

SCALLOPS
Determination of Polyaromatic Hydrocarbons in Scallops (Pecten maximus) by UV Fluorescence and HPLC Combined with UV and Fluorescence Detectors,
W85-04474 5B

SCOTLAND
Bowhouse Sewerage and Sewage Disposal Scheme of Fife Regional Council,
W85-04508 5D

SCOUR
Consideration of Sediment Transport when Calculating Local Scour,
W85-04427 2J

Computing Degradation and Local Scour,
W85-04934 2J

SCREENS
Screening: A New Approach,
W85-04523 5D

SEABIRDS
Concentrations of Seabirds Along the Face of Glaciers and Outlets of Rivers in Svalbard (Konsentrasjoner av sjofugl langs kanten av isbreer og utenfor breelver pa Svalbard),
W85-04608 2L

SEAGRASSES
Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

SEASONAL VARIATION
Seasonal Variation of the Major Cation Content of the Varzea-Lake Lago Camaleao, Middle Amazon, Brazil, in 1981 and 1982,
W85-04570 2H

Seasonal Variation of Nutrient Limitation in Western Lake Erie,
W85-04719 2H

Seasonal Variations in Four Bacterial Size Fractions from a Hypertrophic Pond in Tokyo, Japan,
W85-04912 2H

Exploiting Seasonal Energy from Small Hydropower Stations,
W85-04948 6B

SEATTLE
Biomanipulation Experiment in Green Lake, Seattle, Washington,
W85-04671 5G

SEAWATER
Effects of Dechlorinated Seawater on Fish Behavior,
W85-04862 5D

SEDIMENT
Effect of Methylene Chloride on Respiration and Electron Transport System (ETS) Activity in Freshwater Sediment,
W85-04475 5C

SEDIMENT BUDGET
Sediment Budget Study of Clamshell Dredging and Ocean Disposal Activities in the New York Bight,
W85-04598 6G

SEDIMENT CONTROL
Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

SEDIMENT STORAGE
Sediment Storage and Terrace Formation in Coyote Gulch Basin, South-Central Utah,
W85-04646 2J

SEDIMENT TRANSPORT
Consideration of Sediment Transport when Calculating Local Scour,
W85-04427 2J

Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

Runoff and Sediment Transport Within and From Small Agricultural Watersheds,
W85-04734 2J

Physical Processes and Pollution in the Waters of Spencer Gulf,
W85-04763 2L

SEDIMENT-WATER INTERFACE
Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

Predicting the Effect of Macrobenthos on the Sediment/Water Flux of Metals and Phosphorus,
W85-04839 2K

SEDIMENTATION
Watershed Rehabilitation Program Related to the Management of River and Reservoir Sedimentation in Indonesia,
W85-04438 4D

Reservoir Sedimentation in India -- Its Causes, Control, and Future Course of Action,
W85-04439 6G

Managment of Sedimentation in Bangladesh,
W85-04440 2J

Economic/Institutional Issues in Sedimentation Management in Developing Countries,
W85-04443 4D

Management of Sediment in New South Wales, Australia,
W85-04444 4D

Sedimentation in New Zealand Hydroelectric Schemes,
W85-04445 2J

Sedimentation Problem in Water Conservancy in China,
W85-04446 4D

Physical and Economic Impacts of Sedimentation on Fishing Activities; Nam Pong Basin, Northeast Thailand,
W85-04448 5C

Impact of Sedimentation on the Phosphorus Content of the Euphotic Zone of Lake Constance,
W85-04555 2H

Carbon Mineralization in Microaerobic and Anaerobic Strata of Lake Vechten (The Netherlands): Diffusion Flux Calculations and Sedimentation Measurements,
W85-04702 2H

Sediment Detention Pond Model Using CSTRS Mixing Theory,
W85-04731 5E

Mathematical Model for Reservoir Sedimentation Planning,
W85-04785 6A

Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

SEDIMENTATION BASINS
Sediment Detention Pond Model Using CSTRS Mixing Theory,
W85-04731 5E

SEDIMENTATION RATES
Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

SEDIMENTOLOGY
Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

SEDIMENTS
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

Bioturbation and Microbial Activity,
W85-04704 2L

Sedimentology and Geochemistry of Modern Sediments in the Kingston Basin of Lake Ontario,
W85-04714 2H

Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel,
W85-04863 5B

Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

SEEPAGE
Decomissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

SELENASTRUM
Influence of Light on the Alkaline Phosphatase Activity of Selenastrum capricornutum (Chlorophycese) in Streams,
W85-04849 2H

SELENASTRUM BOTTLE TEST
Comparison of the Selenastrum Bottle Test and the Natural Phytoplankton Assay in Algal Toxicity Tests,
W85-04615 5A

SELENIUM
Content and Chemical Form of Mercury and Selenium in Lake Ontario Salmon and Trout,
W85-04717 5C

SENSITIVITY ANALYSIS
Sensitivity Analysis of Reservoir Oxygen Model,
W85-04585 2H

SEPARATION TECHNIQUES
Control and Treatment Technology for the Metal Finishing Industry. Ion Exchange.
W85-04931 5D

SESTON
Seston-Epipelon Interrelationships in the Shallow Eutrophic Loosdrecht Lakes (The Netherlands),
W85-04547 2H

SETTLING BASINS
Sediment Detention Pond Model Using CSTRS Mixing Theory,
W85-04731 5E

SEWER INFILTRATION
Determining Extraneous Flows in Waste Water Systems,
W85-04689 8A

SEWER INFLOW
Determining Extraneous Flows in Waste Water Systems,
W85-04689 8A

SEWER SYSTEMS
Measurement of the Performance of Sewerage Systems and Associated Hydraulic Structures - Recent Developments,
W85-04511 5D

Present Techniques for 'In-Situ' Sewer Renovation,
W85-04518 8F

Determining Extraneous Flows in Waste Water Systems,
W85-04689 8A

Solving the Problem of Rehabilitating Decayed Sewer Systems,
W85-04768 8A

Sewage Pump Station Design for Barrow, Alaska,
W85-04926 8C

SEWERS
Developments in Materials and Design Techniques for Sewerage Systems,
W85-04517 8A

Relining: The Feasibility of Inserting Pipe into Existing Sewers,
W85-04693 8A

SHELLFISH
Trace Metal Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04436 5B

Organochlorine Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04437 5B

PCBs, DDTs and Other Chlorinated Hydrocarbons in Marine Organisms from the Mediterranean Coast of Israel,
W85-04894 5B

SHELTERBREAKS
System of Practices for Preventing Water by Agricultural Chemicals,
W85-04619 5G

SHINERS
Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

SHORT CIRCUIT METABOLISM
Measurement and Comparative Values of the Short Circuit Metabolism (SCM) of Lakes by POC Relationship of Primary Production of Phytoplankton and Settling Matter,
W85-04701 2H

SHREDDERS
Shredder Abundance and Leaf Breakdown in an Appalachian Mountain Stream,
W85-04899 2H

SHRIMP
Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

SIDESTREAM SOFTENING
Enhance Cooling-Water Reuse with Sidestream Softening,
W85-04469 5F

SIERRA NEVADA
Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes,
W85-04789 5C

SILICIC ACID
Ion Chromatographic Determination of Silicic Acid in Natural Water,
W85-04623 2K

SILICON
Geochemistry of Inorganic Germanium In Natural Waters,
W85-04482 2K

Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

SIMULATION
Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; 2. Numerical Simulation,
W85-04788 5B

SIZE DISTRIBUTION
Sprinkler Droplet Size Distribution Estimation from Single Leg Test Data,
W85-04745 8C

SLIPSTREAM FILTRATION
Control of Suspended Solids in Open Cooling Water Systems,
W85-04820 5F

SLOPE DEGRADATION
Computing Degradation and Local Scour,
W85-04934 2J

SLUDGE CONDITIONING
Influence of the Charge Density of Cationic Polyelectrolytes on Sludge Conditioning,
W85-04494 5D

Destruction of Pathogens and Parasites in Sewage Sludge by Chemical Means,
W85-04592 5E

SLUDGE DIGESTION
Accelerated Cold Digestion: A New Look at an Old Technique,
W85-04591 5D

SLUDGE DISPOSAL
Sewage Sludge Treatment and Disposal - The Way Ahead,
W85-04455 5E

Changes in the Extractabilities of the Heavy Metals in Water-Logged Sludge-Treated Soils,
W85-04514 5E

Availability to Plants of Phosphate in Sludges Precipitated from the Effluent from Sewage Treatment,
W85-04597 5E

Let the Seas Do the Disposal,
W85-04648 5E

Thermal Treatment 'Energizes' San Mateo Sludge,
W85-04649 5E

Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

SLUDGE DRYING
Drier Sludge Ends Landfill Leaching Concerns,
W85-04650 5D

SLUDGE THICKENING
Unified Analysis of Thickening,
W85-04964 5E

SLUDGE TREATMENT
Thermal Treatment 'Energizes' San Mateo Sludge,
W85-04649 5E

Drier Sludge Ends Landfill Leaching Concerns,
W85-04650 5D

Commercial Mining Technique Offers a New Approach to Removing Heavy Metals from Sludges,
W85-04767 5D

Sewage Plant Provides Energy for District Heating System,
W85-04770 5D

SLUDGE UTILIZATION
Revolutionary Experiments Turn Sludge into Fuel,
W85-04771 5E

SMALL HYDROPOWER
Increasing Interest of Public Electricity Suppliers in Micro Power Plants (Aufleben kleiner Wasserkrafte auch beim offentlichen Elektrizitatsversorgungsunternehmen),
W85-04628 6C

Small Hydro in China: Progress and Prospects,
W85-04947 6B

Exploiting Seasonal Energy from Small Hydropower Stations,
W85-04948 6B

Role of Small Hydro in Rural Electrification,
W85-04949 6B

SMELTERS
Migration and Speciation of Lead in a River System Heavily Polluted From a Smelter,
W85-04484 5B

SNOW
Atmospheric Heavy Metals in High Altitude Surface Snows From Mont Blanc, French Alps,
W85-04501 5B

Snow Pollution and Its Effect on Heavy Metals Load of the Kozlowa Gora Reservoir as Compared to Rain and River Water,
W85-04611 5B

SOCIAL PARTICIPATION
Apples and Oranges: Toward a Critique of Public Participation in Great Lakes Decisions,
W85-04573 6A

SODIUM CARBONATE
Acidified Lakes: Ecosystem Response Folowing Sediment Treatment with Sodium Carbonate,
W85-04539 5G

SOIL CHEMISTRY
Attenuation of Chemical Elements in Acidic Leachates from Coal Mineral Wastes by Soils,
W85-04600 5B

Saline Irrigation Water: Effects on Soil Chemical and Physical Properties,
W85-04618 3C

Effects of a Textile Factory Effluent on Soil and Crop Plants,
W85-04945 5D

SOIL CONSERVATION
Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

SOIL EROSION
Prediction of Soil Erosion by Water and Wind for Various Fractions of Cover,
W85-04732 2J

Method of Measuring Aggregate Stability Under Waterdrop Impact,
W85-04733 2J

Tillage Influences on Erosion During Furrow Irrigation,
W85-04749 4C

SOIL HYDRAULIC PROPERTIES
Comparison of Field- and Laboratory-Measured and Predicted Hydraulic Properties of a Soil with Macropores,
W85-04617 2G

SOIL LOSS
Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

SOIL PHYSICAL PROPERTIES
Saline Irrigation Water: Effects on Soil Chemical and Physical Properties,
W85-04618 3C

SOIL PROPERTIES
Pedologic Properties of New Jersey Tidal Marshes,
W85-04955 2L

SOIL TEXTURE
Coarse Fraction of Soils: The Role it Plays in Plant Nutrition, Liming and Irrigation,
W85-04823 2G

SOIL WATER
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry,
W85-04792 5C

Movement of Water in a Plinthic Paleudult Using a Bromide Tracer,
W85-04957 2G

SOIL WATER TENSION
Relationships among Oxygen Flux, Soil Water Tension, and Aeration Porosity in a Drying Soil Profile,
W85-04956 2G

SOLAR RADIATION
Influence of Light on the Alkaline Phosphatase Activity of Selenastrum capricornutum (Chlorophycese) in Streams,
W85-04849 2H

SOLUTE TRANSPORT
Migration and Attenuation of Selected Organics in a Sandy Aquifer - A Natural Gradient Experiment,
W85-04635 5B

SORPTION
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

SOURCE OF POLLUTANTS
Migration and Speciation of Lead in a River System Heavily Polluted From a Smelter,
W85-04484 5B

SOUTH AFRICA
Research Related to Water Pollution Control in South Africa,
W85-04456 5D

Water for the Flats.
W85-04811 4A

Sensitivity of Stone Fruit Rootstocks to Waterlogging,
W85-04812 2I

Convert the Brook on Your Farm to Electric Current,
W85-04813 8C

Diatoms of the Jukskei-Crocodile River System (Transvaal, Republic of South Africa): A Preliminary Check-List,
W85-04814 2H

Temperature-Growth Rate Relationships of Aerobic Heterotrophic Bacteria Isolated from a Silt-laden Impoundment,
W85-04815 2H

Studies on the Zoobenthos of Some Southern Cape Coastal Lakes. Spatial and Temporal Changes in the Benthos of Swartvlei, South Africa, in Relation to Changes in the Submerged Littoral Macrophyte Community,
W85-04818 2H

Control of Suspended Solids in Open Cooling Water Systems,
W85-04820 5F

Need for Chemical Phosphate Removal,
W85-04821 5D

SOUTH AUSTRALIA
Regional Variation in the Distribution of Trace Metals in Modern Intertidal Sediments of Northern Spencer Gulf, South Australia,
W85-04764 5B

SOUTH CAROLINA
Quiescence, Growth and Senescence of Egeria densa in Lake Marion,
W85-04858 2H

SPATIAL DISTRIBUTION
Spatial Distributions of Precipitation Acidity and Major Ion Wet Deposition in North America During 1980,
W85-04647 5B

SPECIATION
Importance of Speciation Methods in Analytical Control of Water Treatment Processes With Application to Fluoride Removal From Waste Waters,
W85-04485 5A

SPECIES COMPOSITION
Phytoplankton in 151 Eastern Finnish Lakes: Species Composition and its Relations to the Water Chemistry,
W85-04543 2H

Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

Analysis of Changes in the Invertebrate Community Along a Southern New Zealand Montane Stream,
W85-04724 2H

SPECIES DIVERSITY
BASIC Program for the Investigation of Species Diversity,
W85-04513 7C

Species Richness in Streams of Different Size from the Same Drainage Basin,
W85-04665 2H

Analysis of Changes in the Invertebrate Community Along a Southern New Zealand Montane Stream,
W85-04724 2H

SPECIFIC YIELD
Role of Specific Yield in Ground-Water Recharge Estimations: A Numerical Study,
W85-04640 2F

SPECTROMETRY
Preconcentration of Submicrogram Amounts of Metals from Natural Waters for X-ray Energy Spectrometric Determination Using Pyrrolidinecarbodithioic Acid,
W85-04621 5A

SPENCER GULF
Physical Processes and Pollution in the Waters of Spencer Gulf,
W85-04763 2L

Regional Variation in the Distribution of Trace Metals in Modern Intertidal Sediments of Northern Spencer Gulf, South Australia,
W85-04764 5B

SPILLWAYS
High-Head Spillway with Swirling of the Flow in the Outlet Section,
W85-04420 8A

SPOIL BANKS
Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas,
W85-04480 5B

SPOKANE RIVER
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

SPRINKLERS
Sprinkler Droplet Size Distribution Estimation from Single Leg Test Data,
W85-04745 8C

ST. LAWRENCE ESTUARY
Near Bottom Variations of Turbidity in the St. Lawrence Estuary,
W85-04677 2L

ST. LAWRENCE RIVER
PCBs and Organochlorine Pesticides in the St. Lawrence System (BPC ET Pesticides Organochlores Dans Le Systeme Saint-Laurent),
W85-04581 5B

STABILIZATION LAGOONS
BOD Removal Efficiencies in Two Stabilization Lagoons in Series in Malaysia,
W85-04515 5D

STABILIZATION PONDS
Dispersion Model for Waste Stabilization Ponds,
W85-04966 5D

STANDARDS
Subchronic Effects of a Mixture of 'Persistent' Chemicals Found in the Great Lakes,
W85-04479 5C

STANDING CROPS
Leaf Area as a Measure of Standing Crop of Floating Aquatic Macrophytes,
W85-04817 2H

STATISTICAL STUDIES
Statistical Inference for Point Process Models of Rainfall,
W85-04794 2B

STATISTICS
Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

STEEL INDUSTRY
Recovery of Spent Sulfuric Acid from Steel Pickling Operations.
W85-04933 5E

STEM FLOW
Throughfall and Stem Flow in Mature and Year-Old Wet Tropical Forest,
W85-04853 2I

STOCHASTIC PROCESS
Stochastic Modeling of Groundwater Flow by Unconditional and Conditional Probabilities: The Inverse Problem,
W85-04793 2F

STOMATA
Stomatal Responses to Leaf Water Potentials of Drip Irrigated Peach (Prunus persica),
W85-04746 2I

STORM RUNOFF
Flow Balancing System for Stormwater and Combined Sewer Overflow,
W85-04772 5D

Residence Time in Stormwater Detention Basins,
W85-04968 5D

STORM SEEPAGE
Movement of Water in a Plinthic Paleudult Using a Bromide Tracer,
W85-04957 2G

STORM WASTEWATER
Zero Side Yard Housing, Acceptance and Stormwater Management Implications,
W85-04580 4A

STORM WATER
Linear Programming Model for the Control of Combined Sewer Systems with Off-Line Storage Facilities,
W85-04576 5G

STORMS
Contrast in Stream-Channel Response to Major Storms in Two Mountainous Areas of California,
W85-04836 2J

STRATIFICATION
Diurnal Cycle of Stratification in Lake Titicaca: Eddy Diffusion,
W85-04567 2H

Amazon Floodplain Lakes: Shape, Fetch, and Stratification,
W85-04568 2H

STREAM ORDER
Shredder Abundance and Leaf Breakdown in an Appalachian Mountain Stream,
W85-04899 2H

STREAM SEDIMENTS
Composition and Possible Origin of Detrital Material in Streams,
W85-04827 2J

STREAMFLOW
Effects of Land Drainage on Stream Flow,
W85-04583 4C

Preliminary Investigation on Effects of Fluctuating Flows on Invertebrates of the Hawea River, a Large Regulated River in New Zealand,
W85-04668 2H

Extension of a Streamflow Time Series by Regression (Verlangerung einer Zeitreihe des Durchflusses mit Hilfe eines Regressionsmodells),
W85-04807 2E

STREAMS
Species Richness in Streams of Different Size from the Same Drainage Basin,
W85-04665 2H

Analysis of Changes in the Invertebrate Community Along a Southern New Zealand Montane Stream,
W85-04724 2H

Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry,
W85-04792 5C

Convert the Brook on Your Farm to Electric Current,
W85-04813 8C

Changes in the Oxygen Balance of a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Zuurstofbalans van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04889 5G

STRESS
Confinement and Water Quality-Induced Stress in Largemouth Bass,
W85-04680 5C

Comparative Study of Respiration Rates of Some Aquatic Oligochaetes in Relation to Sublethal Stress,
W85-04905 5C

SUBARCTIC LAKES
Experimental Lake Fertilization in the Kuokkel Area, Northern Sweden. Phytoplankton Biomass and Algal Composition in Natural and Fertilized Subarctic Lakes,
W85-04910 2H

SUBARCTIC ZONE
Phytoplankton in a Polluted Subarctic Lake Before and After Nutrient Reduction,
W85-04490 5C

Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

SUBIRRIGATION
Effect of Drain Tube Openings on Drainage and Subirrigation,
W85-04748 4A

SUBSTRATES
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

SUBSURFACE DRAINAGE
Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

SUBSURFACE MATERIAL
Determination of Microbial Cell Numbers in Subsurface Samples,
W85-04636 5A

SUCCESSION
Impact of Nutrient Load on Total Biomass and Species Succession in Lake Suwa, Japan,
W85-04565 5C

SULFATE REDUCTION
Effects of Organic Pollutants on Methanogenesis, Sulfate Reduction and Carbon Dioxide Evolution in Salt Marsh Sediments,
W85-04872 5C

SULFATES
Estimation of Sulphate Ions in Water and Industrial Wastes Using a Solid State Membrane Electrode,
W85-04488 7B

Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

SULFIDES
Tip Leachate Treatment Using Hydrogen Peroxide,
W85-04522 5D

SULFUR
Regional River Sulfur Runoff,
W85-04481 5B

Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

SULFUR COMPOUNDS
Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

SULFUR DIOXIDE
Rainborne SO2, Precipitation pH and Airborne SO2 Over Short Sampling Times Throughout Individual Events,
W85-04500 5B

SULFURIC ACID
Recovery of Spent Sulfuric Acid from Steel Pickling Operations.
W85-04933 5E

SUPERSATURATION
Gas Supersaturation as a Cause of Early Spring Mortality of Stocked Trout,
W85-04844 2H

SURFACE LAYERS
Small-scale Temporal Changes in the Biological and Chemical Composition of Surface Microlayers in a Eutrophic Lake,
W85-04538 2H

SURFACE MICROLAYERS
Retrieval of Material from the Surface Microlayer with Screen and Plate Samplers and its Implications for Partitioning of Material within the Microlayer,
W85-04895 5A

SURFACE MINING
Potential Effects on Ground Water of a Hypothetical Surface Coal Mine in Indiana,
W85-04418 4C

SURFACE WATERS
Health and Amenity Aspects of Surface Waters,
W85-04457 5G

Time Series Models for Treatment of Surface Waters,
W85-04965 5F

SURGE TANKS
Mathematical Modeling of Hydraulic Regimes in the Transition Between the Surge Tank and Conduits of a Hydroelectric Station,
W85-04419 8B

Optimization of Design Parameters of Complex Surge Tanks,
W85-04426 8A

SUSPENDED LOAD
Method to Measure Suspended Load Transports in Estuaries,
W85-04675 2L

Near Bottom Variations of Turbidity in the St. Lawrence Estuary,
W85-04677 2L

SUSPENDED SOLIDS
Chemical Flocculation for Suspended Solids Removal at Remote Mine Sites,
W85-04730 5D

Control of Suspended Solids in Open Cooling Water Systems,
W85-04820 5F

Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

Influence of Suspended Particle Size Distribution in Deep-Bed Filtration,
W85-04876 5F

SVALBARD
Concentrations of Seabirds Along the Face of Glaciers and Outlets of Rivers in Svalbard (Konsentrasjoner av sjofugl langs kanten av isbreer og utenfor breelver pa Svalbard),
W85-04608 2L

SWAMPS
Typhetum angustifoliae and Typhetum latifoliae as Indicators of Various Habitats,
W85-04614 2L

SWARTVLEI LAKE
Studies on the Zoobenthos of Some Southern Cape Coastal Lakes. Spatial and Temporal Changes in the Benthos of Swartvlei, South Africa, in Relation to Changes in the Submerged Littoral Macrophyte Community,
W85-04818 2H

SWEDEN
Phytoplankton in a Polluted Subarctic Lake Before and After Nutrient Reduction,
W85-04490 5C

Experimental Lake Fertilization: Turnover of Nitrogen and Phosphorus in Stratified and Non-Statified Subarctic Lakes in Northern Sweden,
W85-04534 2H

Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

Variation of Water Quality Parameters in Meso- to Hypereutrophic Lakes,
W85-04536 2H

Short-term Effects of Liming on Sediment Oxygen Uptake in an Acid lake,
W85-04537 5G

Acidified Lakes: Ecosystem Response Folowing Sediment Treatment with Sodium Carbonate,
W85-04539 5G

SWELLING SOILS
Infiltration in Swelling Soils,
W85-04790 2G

SWIMMING
Use of Bacteriological Indicators for Swimming Water Quality,
W85-04765 5A

SWITZERLAND
Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions),
W85-04559 5G

5-alpha(H)-Cholestan-3-alpha-ol in Sediments: Characterization and Geochemical Significance,
W85-04759 2K

SYNTHETIC FUELS
Wastewater Treatment Systems for Synthetic Fuels Plants Based on Peat and Oil Shale,
W85-04880 5D

TADCASTER
Industrial Effluent Treatment at Sewage-Treatment Works: The Tadcaster Experience,
W85-04521 5D

TAME BASIN
Water Reclamation and River Management in the Tame Basin,
W85-04460 5G

TAME RIVER
Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

TANA RIVER
Masinga Dam in Kenya,
W85-04471 8A

TANDEM MASS SPECTROMETRY
Scheme for the Direct Analysis of Organics in the Environment by Tandem Mass Spectrometry,
W85-04656 5A

TANKS
Problems with Traditional Small Reservoir Irrigation Systems in the Semi Arid Tropics,
W85-04747 4A

TEAPOT LAKE
Aquatic Macrophyte Vegetation of an Isolated Island Lake Adjacent to Lake Nipigon, Ontario: A Comparative Study After a Fifty-six Year Interval,
W85-04661 2H

TEES ESTUARY
Pollution Control Policies for the Tees Estuary,
W85-04525 5G

TEMPLETON
Macroinvertebrates in a Sewage-Polluted Aquifer,
W85-04720 5C

TENCH
Effect of Water Temperature Elevation on Incipient and Cumulative Fecundity of Batch-Spawning Tench, Tinca tinca (L.),
W85-04707 8I

TERNS
Organochlorine Residues in Common Terns and Associated Estuarine Organisms, Massachusetts, USA, 1971-81,
W85-04861 5B

TERRACES
Sediment Storage and Terrace Formation in Coyote Gulch Basin, South-Central Utah,
W85-04646 2J

TETRACHLOROETHYLENE
Leaching of Tetrachloroethylene from Vinyl-Lined Pipe,
W85-04963 5F

TEXAS
Phytoplankton Production in the Corpus Christi Bay Estuary,
W85-04432 2L

Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas,
W85-04480 5B

Brackish Water in Unsaturated Confining Beds at a Texas Lignite Mine,
W85-04639 2F

TEXTILE MILL WASTES
Effects of a Textile Factory Effluent on Soil and Crop Plants,
W85-04945 5D

THAILAND
Physical and Economic Impacts of Sedimentation on Fishing Activities; Nam Pong Basin, Northeast Thailand,
W85-04448 5C

THAMES RIVER
Biological Considerations in the Setting of Quality Standards for the Tidal Thames,
W85-04509 5G

Pollution Management and the Tidal Thames,
W85-04527 5G

THEORETICAL ANALYSIS
Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

THERMAL POLLUTION
Effects of Power Station Cooling Water Discharges on Aquatic Ecology,
W85-04507 5C

Some Remarks on the Ecology of Algae in Heated Waters (Uwagi o ekologii glonow w wodach podgrzanych),
W85-04609 5C

Thermal Mortality Prediction Equations for Entrainable Striped Bass,
W85-04682 5C

Manatee Use of Power Plant Effluents in Brevard County, Florida,
W85-04696 5C

THERMAL TREATMENT
Thermal Treatment 'Energizes' San Mateo Sludge,
W85-04649 5E

THROUGHFALL
Throughfall and Stem Flow in Mature and Year-Old Wet Tropical Forest,
W85-04853 2I

TIDAL FLATS
Study of Domestic Sewage Waste Treatment by the Polychaetes, Neanthes japonica and Perinereis nuntia var. vallata, on an Artificial Tidal Flat,
W85-04903 5D

TIDAL MARSHES
Pedologic Properties of New Jersey Tidal Marshes,
W85-04955 2L

TIDAL WATERS
Pollution Management and the Tidal Thames,
W85-04527 5G

TILE DRAINAGE
Simulated Effects of Fertilizer Management on Nitrate Loss with Tile Drainage Water for Continuous Corn,
W85-04739 6G

TILLAGE
Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

Tillage Influences on Erosion During Furrow Irrigation,
W85-04749 4C

TIME SERIES ANALYSIS
Time Series Models for Treatment of Surface Waters,
W85-04965 5F

TITANIUM DIOXIDE
Toxicity of Effluents from a TiO2 Plant to the Harpacticoid Copepod Nitocra spinipes Boeck,
W85-04866 5C

TOPOGRAPHY
Unlined High Pressure Tunnels in Areas of Complex Topography,
W85-04412 8A

TOXICITY
In Vivo Effects of Cadmium on Some Enzyme Activities in Tissues of the Freshwater Catfish, Heteropneustes fossilis,
W85-04434 5C

Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies,
W85-04435 5C

Subchronic Effects of a Mixture of 'Persistent' Chemicals Found in the Great Lakes,
W85-04479 5C

Biodegradability of Two Primary Alcohol Ethoxylate Nonionic Surfactants Under Practical Conditions, and the Toxicity of the Biodegradation Products to Rainbow Trout,
W85-04487 5D

Comparison of the Selenastrum Bottle Test and the Natural Phytoplankton Assay in Algal Toxicity Tests,
W85-04615 5A

Effects of Four Heavy Metals on Survival and Hatching Rate of Artemia salina (L.),
W85-04674 5C

Tolerance to and Uptake of Lead in the Green Mussel, Perna viridis (L.),
W85-04708 5C

Copper Complexation and Toxicity to Daphnia in Natural Waters,
W85-04716 5C

Toxicity of Effluents from a TiO2 Plant to the Harpacticoid Copepod Nitocra spinipes Boeck,
W85-04866 5C

Effects of Mercury on the Prosobranch Mollusc Crepidula fornicata: Acute Lethal Toxicity and Effects on Growth and Reproduction of Chronic Exposure,
W85-04867 5C

Acute Toxicity of Copper to Three Life Stages of Chrionomus tentans as Affected by Water Hardness-Alkalinity,
W85-04946 5C

TOXINS
Specific Ultraviolet Absorbance Band of Microcystis aeruginosa Toxins,
W85-04816 5A

TRACE METALS
Trace Metal Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04436 5B

Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

Preconcentration of Submicrogram Amounts of Metals from Natural Waters for X-ray Energy Spectrometric Determination Using Pyrrolidinecarbodithioic Acid,
W85-04621 5A

Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides,
W85-04757 5B

Regional Variation in the Distribution of Trace Metals in Modern Intertidal Sediments of Northern Spencer Gulf, South Australia,
W85-04764 5B

Trace Metal-Binding Proteins in Marine Molluscs and Crustaceans,
W85-04873 5C

Trace Metal and PCB Content of Mussels (Mytilus edulis) from the Southwestern Baltic Sea,
W85-04902 5B

TRACERS
Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

Determination of Spreading of Nutritive Salts in Quasi-Stagnant Waters by Using Lithium (Chloride) as Tracer and Continuous Measurement of Water-Quality Parameters (Die Bestimmung von Ausbreitungsvorgangen von Nahrsalzen in quasi stehenden Gewassern unter Verwendung des Tracers Lithium (Chlorid) und die kontinuierliche Messung von Wasserguteparametern),
W85-04810 5A

TRANSMISSION LINES
Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

TRAVEL COST METHOD
Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality,
W85-04753 6B

TREATED WATER
Acceptance of Treated Water by Northern Community Residents,
W85-04921 6D

TREATMENT PLANTS
Practical Aspects of Energy Saving in Wastewater Disposal,
W85-04595 5D

TREE SCARS
Trees Scars to Determine the Frequency and Stage of High Magnitude River Ice Drives and Jams, Red Deer, Alberta,
W85-04589 7B

TREES
D/H Ratios of Sap in Trees: Implications for Water Sources and Tree Ring D/H Ratios,
W85-04758 2I

TRENCHES
Prediction and Control of Ground Movement Associated with Trench Excavation,
W85-04516 8D

TRIALKYL PHOSPHATES
Determination of Trialkyl and Triaryl Phosphates in Environmental Samples,
W85-04497 5B

TRIARYL PHOSPHATES
Determination of Trialkyl and Triaryl Phosphates in Environmental Samples,
W85-04497 5B

TRICHLOROACETIC ACID
Effects of Trichloroacetic Acid, a New Contaminant Found from Chlorinating Water with Organic Material, on Dragonfly Nymphs,
W85-04478 5C

TROPHIC LEVEL
Phytoplankton as Biological Parameter for the Trophic Characterization of Lakes,
W85-04561 2H

Cellular Phosphorus Concentration as a Criterion for Trophic Status in Rapidly Flushed Lakes,
W85-04846 2H

TROPHIC LEVELS
Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

Protozoan Colonization Rates and Trophic Status of Some Freshwater Wetland Lakes,
W85-04657 2H

TROPICAL FORESTS
Throughfall and Stem Flow in Mature and Year-Old Wet Tropical Forest,
W85-04853 2I

TROPICAL REGIONS
Comparative Studies of NO3- Concentrations in Some Tropical Rains,
W85-04506 5B

TROPICAL ZONE
Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

TROUT
Biodegradability of Two Primary Alcohol Ethoxylate Nonionic Surfactants Under Practical Conditions, and the Toxicity of the Biodegradation Products to Rainbow Trout,
W85-04487 5D

Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

Content and Chemical Form of Mercury and Selenium in Lake Ontario Salmon and Trout,
W85-04717 5C

Gas Supersaturation as a Cause of Early Spring Mortality of Stocked Trout,
W85-04844 2H

Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

TUBES
Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

TUNNEL CONSTRUCTION
Underwater Piercing of a Tunnel,
W85-04415 8A

TUNNEL LININGS
Long-Term Prestress in Concrete-Lined Pressure Tunnels,
W85-04414 8F

TUNNELS
Unlined High Pressure Tunnels in Areas of Complex Topography,
W85-04412 8A

Economizing the Diameter of Tunnels,
W85-04413 8A

Malawi - Driving a 9 m Diameter Power Conduit with Low Cover at Nkula Falls,
W85-04819 8A

TURBIDITY
Near Bottom Variations of Turbidity in the St. Lawrence Estuary,
W85-04677 2L

TYPHETUM
Typhetum angustifoliae and Typhetum latifoliae as Indicators of Various Habitats,
W85-04614 2L

ULTRAVIOLET ABSORPTION
Specific Ultraviolet Absorbance Band of Microcystis aeruginosa Toxins,
W85-04816 5A

UNCERTAINTY
Measurements and Estimation in Hydrology - Ideas and Proposals for the Quantification of Errors and Uncertainties (Messungen und Schatzungen in der Hydrologie - Gedanken und Vorschlage zur Quantifizierung der Fehler und Unsicherheiten),
W85-04805 7B

UNDERGROUND STRUCTURES
Underground Utilities in Barrow, Alaska,
W85-04925 6A

UNDERGROUND WASTE DISPOSAL
Underground Utilities in Barrow, Alaska,
W85-04925 6A

UNITED KINGDOM
Sewage Sludge Treatment and Disposal - The Way Ahead,
W85-04455 5E

Health and Amenity Aspects of Surface Waters,
W85-04457 5G

UNITED STATES
International Water Management in Canadian-American Relations, 1894-1907,
W85-04588 6E

UNSATURATED FLOW
Galerkin Finite-Element Program for Simulating Unsaturated Flow in Porous Media,
W85-04645 2F

UNSTEADY FLOW
Discontinuous Wave on Stretches of an Abrupt Expansion of a Canal,
W85-04424 8B

UNSTREADY FLOW
Pressure Rises Due to Unsteady Flow, Especially in High-Lift Navigation Locks (Druckerhohungen aufgrund instationarer Stromungsvorgange, insbesondere in Schiffsschleusen mit grossen Stufenhohen),
W85-04631 8B

UPPER CAMPBELL LAKE
Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

UPPER SPENCER GULF
Fluid Transport Processes in Upper Spencer Gulf,
W85-04762 2L

UPWELLING
Concentrations of Seabirds Along the Face of Glaciers and Outlets of Rivers in Svalbard (Konsentrasjoner av sjofugl langs kanten av isbreer og utenfor breelver pa Svalbard),
W85-04608 2L

URBAN DRAINAGE
Comparison of Dynamic Flow Routing Methods for Urban Drainage Systems (Vergleich hydrodynamischer Berechnungsansatze zur Abfluebermittlung in Kanalnetzen),
W85-04627 8B

URBAN RUNOFF
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

URIBANTE-DORADAS DEVELOPMENT
Uribante-Doradas Hydro Development in Venezuela,
W85-04783 8A

USSR
Investigation of the Stability of River and Canal Channels,
W85-04422 2J

Experience in Operating the Bratsk Reservoir,
W85-04429 4A

UTAH
Sediment Storage and Terrace Formation in Coyote Gulch Basin, South-Central Utah,
W85-04646 2J

Fire and Herbivory in a Great Salt Lake Marsh,
W85-04825 2L

UTILITIES
Water Utility in the Nuclear Age,
W85-04773 5B

Status of Sanitation Facilities in Alaska - 1982,
W85-04915 6B

Utilities Delivery for the Indian and Inuit Affairs Program,
W85-04916 6B

Study of Water Bleeder Control Alternatives,
W85-04922 3D

Sewage Pump Station Design for Barrow, Alaska,
W85-04926 8C

UTRATA RIVER
Phosphorus, Nitrogen, and Carbon Cycling by Fish Populations in Two Small Lowland Rivers in Poland,
W85-04888 5B

VALUE
Proposed Framework for Developing a Multidisciplinary Wetlands Valuation Model,
W85-04684 2L

VANCOUVER ISLAND
Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

VARIEGATED GLACIER
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

VARZEA LAKES
Seasonal Variation of the Major Cation Content of the Varzea-Lake Lago Camaleao, Middle Amazon, Brazil, in 1981 and 1982,
W85-04570 2H

VEGETATION
Rainfall Interception on a Small Forested Watershed within the Kawartha Lakes Region,
W85-04578 2I

Vegetation and Primary Production in a Floating Freshwater Marsh in Louisiana,
W85-04855 2L

VENEZUELA
Uribante-Doradas Hydro Development in Venezuela,
W85-04783 8A

VERMONT
Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

VICTORIA LAND
Thickness of Ice on Perennially Frozen Lakes,
W85-04883 2C

VIRGINIA
Organic Acidity in Precipitation of North America,
W85-04499 5B

Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

Peak Use Charge: An Equitable Approach to Charging for and/or Reducing Summer Peak Use,
W85-04687 6C

Opportunity Costs of Preserving Coastal Wetlands: A Case Study of a Recreational Housing Development,
W85-04754 6B

Human Modification of Molluscan Habitats in Little Creek Estuary, Virginia,
W85-04859 6G

VIRUSES
Comparison of Current Methods of Poliovirus Concentration from Tap Water,
W85-04492 5F

T2-Coliphage Uptake By Mosquito Larvae,
W85-04493 5D

Waterborne Outbreak of Hepatitis A in Meade County, Kentucky,
W85-04658 5C

VOLATILE ACIDS
Capillary Gas Chromatography Determination of Volatile Organic Acids in Rain and Fog Samples,
W85-04959 5A

VOLATILE COMPOUNDS
Use of a Permeation Sampler for Determination of Volatile Priority Pollutants,
W85-04960 5A

VOLGA RIVER
Investigation of the Stability of River and Canal Channels,
W85-04422 2J

VOLTA ESTUARY
Chemical Survey of the Volta Estuary,
W85-04854 2L

VOLTAMMETRY
Determining Trace Concentrations of Copper in Water by Cathodic Film Stripping Voltammetry With Adsorptive Collection,
W85-04410 5A

Voltammetric Methods for Distinguishing between Dissolved and Particulate Metal Ion Concentrations in the Presence of Hydrous Oxides. A Case Study on Lead (II),
W85-04800 5A

WALES
Embryo Abnormalities in the Periwinkle, Littorina 'saxatilis', as Indicators of Stress in Polluted Marine Environments,
W85-04893 5A

WASH WATER
Control and Treatment Technology for the Metal Finishing Industry. In-Plant Changes.
W85-04929 5D

WASHINGTON
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

Biomanipulation Experiment in Green Lake, Seattle, Washington,
W85-04671 5G

WASTE DISPOSAL
Basic Technology of the Pulp and Paper Industry and Its Environmental Protection Practices,
W85-04932 5D

Recovery of Spent Sulfuric Acid from Steel Pickling Operations.
W85-04933 5E

WASTE HEAT
Sewage Plant Provides Energy for District Heating System,
W85-04770 5D

WASTE RECOVERY
Control and Treatment Technology for the Metal Finishing Industry. In-Plant Changes.
W85-04929 5D

Recovery of Spent Sulfuric Acid from Steel Pickling Operations.
W85-04933 5E

WASTEWATER DISPOSAL
Effects of the Recharge on Sewage Effluents Upon the Quality of Chalk Groundwater,
W85-04462 5C

Problems Associated with the Disposal of Trade Effluent to Sewers - Charging and Control,
W85-04463 5E

Wastewater Disposal and Utilization in Agriculture in Poland and Hungary,
W85-04664 5E

WASTEWATER FACILITIES
Measurement of the Performance of Sewerage Systems and Associated Hydraulic Structures - Recent Developments,
W85-04511 5D

Heating Enclosed Wastewater Treatment Facilities with Heat Pumps,
W85-04924 6A

WASTEWATER IRRIGATION
Treatment of Sewage for Use in Municipal Irrigation in Abu Dhabi, UAE,
W85-04464 5D

Wastewater Disposal and Utilization in Agriculture in Poland and Hungary,
W85-04664 5E

Irrigation of Swine Lagoon Effluent onto Pine and Hardwood Forests,
W85-04741 5D

WASTEWATER POLLUTION
Macroinvertebrates in a Sewage-Polluted Aquifer,
W85-04720 5C

Sewage-Derived Bacteria Monitored in a Marine Water Column by Means of Captive Mussels,
W85-04868 5A

Benthic-Pelagic Coupling in Sewage-Affected Marine Ecosystems,
W85-04874 5C

WASTEWATER TREAMENT
Fate of Contaminants During Treatment of H-Coal Process Wastewaters,
W85-04878 5D

WASTEWATER TREATMENT
Pilot-Plant Evaluation of a Deep Shaft Linked to Conventional Aeration Without Inter-Stage Settlement to Give a Fully-Nitrified Effluent,
W85-04452 5D

Sewage Sludge Treatment and Disposal - The Way Ahead,
W85-04455 5E

Treatment of Sewage for Use in Municipal Irrigation in Abu Dhabi, UAE,
W85-04464 5D

Decreasing Rate of Biochemical Oxidation of Sewage,
W85-04468 5D

Importance of Speciation Methods in Analytical Control of Water Treatment Processes With Application to Fluoride Removal From Waste Waters,
W85-04485 5A

Detoxification of Effluents in a Macrophyte Treatment System,
W85-04489 5D

T2-Coliphage Uptake By Mosquito Larvae,
W85-04493 5D

Influence of the Charge Density of Cationic Polyelectrolytes on Sludge Conditioning,
W85-04494 5D

Performance Characteristics of the Anaerobic Baffled Reactor,
W85-04495 5D

Use of Performance Indicators in Sewage Treatment Appraisal,
W85-04510 5D

BOD Removal Efficiencies in Two Stabilization Lagoons in Series in Malaysia,
W85-04515 5D

Industrial Effluent Treatment at Sewage-Treatment Works: The Tadcaster Experience,
W85-04521 5D

Tip Leachate Treatment Using Hydrogen Peroxide,
W85-04522 5D

Nutrient Removal Trials and Bioassay Evaluation at Budds Farm Sewage-Treatment Works, Havant,
W85-04526 5D

Optimization of Coleshill Activated-Sludge Plant Operating Conditions,
W85-04590 5D

Accelerated Cold Digestion: A New Look at an Old Technique,
W85-04591 5D

Aerobic Treatment in 'Oxitron' Biological Fluidized Bed Plant at Coleshill,
W85-04593 5D

Practical Aspects of Energy Saving in Wastewater Disposal,
W85-04595 5D

Treatment of Ferruginous Ground Water from an Abandoned Colliery,
W85-04596 5D

Oxygen Injection Cuts Odors,
W85-04652 5D

Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

Biological Denitrification in a Fluidized Bed,
W85-04660 5D

Microbial Heterotrophic Activity Assessment in a Waste-water Treatment System,
W85-04706 5D

New Ideas Reshaping Treatment Technologies,
W85-04751 5D

Controlling Sewage Treatment Plant Odours,
W85-04769 5D

Sewage Plant Provides Energy for District Heating System,
W85-04770 5D

Need for Chemical Phosphate Removal,
W85-04821 5D

Some Aspects of the Use of Oxidation Techniques in the Treatment of Sewage,
W85-04822 5D

Anaerobic Treatment of Concentrated Industrial Wastewater,
W85-04877 5D

Gasifier Wastewater Treatment: Phase I Cooling Tower Assessment,
W85-04879 5D

Wastewater Treatment Systems for Synthetic Fuels Plants Based on Peat and Oil Shale,
W85-04880 5D

Oxidation of Cyanides in Industrial Wastewaters by Ozone,
W85-04881 5D

Control and Treatment Technology for the Metal Finishing Industry. In-Plant Changes.
W85-04929 5D

Control and Treatment Technology for the Metal Finishing Industry. Ion Exchange.
W85-04931 5D

Basic Technology of the Pulp and Paper Industry and Its Environmental Protection Practices,
W85-04932 5D

Recovery of Spent Sulfuric Acid from Steel Pickling Operations.
W85-04933 5E

Status Report on Abatement of Water Pollution from the Canadian Petroleum Refining Industry - 1980.
W85-04940 5D

Pure O2 Retrofit Doubles Plant's Capacity,
W85-04953 5D

Dispersion Model for Waste Stabilization Ponds,
W85-04966 5D

WASTEWATER TREATMENT FACILITIES
Privatization Needs the Professional Approach,
W85-04954 6A

WASTEWATER TREATMENT FACILITIES
Bowhouse Sewerage and Sewage Disposal Scheme of Fife Regional Council,
W85-04508 5D

Resurrection of Deighton Sewage Treatment Works,
W85-04512 5D

WATER
Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

WATER ANALYSIS
Determining Trace Concentrations of Copper in Water by Cathodic Film Stripping Voltammetry With Adsorptive Collection,
W85-04410 5A

Gas Chromatographic Determination of Picloram in Fish,
W85-04433 5A

Monitoring of River Water Quality within the Great Ouse Basin Using the Chironomid Exuvial Analysis Technique,
W85-04454 5A

Determination of COD by a Mercury-Free Open-Tube Method,
W85-04467 5A

Estimation of Sulphate Ions in Water and Industrial Wastes Using a Solid State Membrane Electrode,
W85-04488 7B

Scheme for the Direct Analysis of Organics in the Environment by Tandem Mass Spectrometry,
W85-04656 5A

WATER BIRDS
Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas,
W85-04480 5B

WATER BLEEDING
Study of Water Bleeder Control Alternatives,
W85-04922 3D

WATER COLOR
Light Penetration and Some Related Characteristics in Small Forest Lakes in Southern Finland,
W85-04542 2H

WATER CONSERVATION
Retrofitting Apartment Buildings To Reduce Costs and Water Demand,
W85-04690 3D

Demand Reduction: Water Conservation Through Leak Detection,
W85-04691 3D

Lawn and Garden Watering Regulations: Conservation Through a Water Use Index,
W85-04695 3D

Arizona Water Issues: Contrasting Economic and Legal Perspectives,
W85-04756 6E

Water Conservation in Barrow, Alaska,
W85-04918 6B

Water Use Reduction Through Metering Could Provide Significant Economic Benefits to Inuvik, N.W.T.,
W85-04919 3D

Water Conservation in the Northwest Territories - Public Education and Awareness Program,
W85-04920 3D

WATER CONVEYANCE
Acid Rain: Dousing Community Resources,
W85-04750 5F

Acceptance of Treated Water by Northern Community Residents,
W85-04921 6D

WATER COSTS
Water Conservation in Barrow, Alaska,
W85-04918 6B

WATER CURRENTS
Method to Measure Suspended Load Transports in Estuaries,
W85-04675 2L

Near Bottom Variations of Turbidity in the St. Lawrence Estuary,
W85-04677 2L

WATER DEMAND
Role of Pricing in Managing the Demand for Water,
W85-04686 6A

Demand Reduction: Water Conservation Through Leak Detection,
W85-04691 3D

WATER DISTRIBUTION
Water Leakage Control and Sonic Detection,
W85-04692 3D

Leaching of Tetrachloroethylene from Vinyl-Lined Pipe,
W85-04963 5F

WATER HAMMER
Experience in the Operation of Hydraulic Structures and Equipment of Hydroelectric Stations,
W85-04423 8C

WATER HYACINTH
Influence of Water Hyacinth Cover on the Physico-Chemical Characteristics of Water and Phytoplankton Composition in a Reservoir near Jaipur (India),
W85-04913 5C

WATER LEVEL FLUCTUATIONS
Groundwater Seepage and the Water Balance of a Closed, Freshwater, Coastal Dune Lake: Lake Windermere, Jervis Bay,
W85-04698 2F

WATER LILY
Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

WATER MAINS
Demand Reduction: Water Conservation Through Leak Detection,
W85-04691 3D

Water Leakage Control and Sonic Detection,
W85-04692 3D

WATER MANAGEMENT
International Water Management in Canadian-American Relations, 1894-1907,
W85-04588 6E

WATER METERING
Water Use Reduction Through Metering Could Provide Significant Economic Benefits to Inuvik, N.W.T.,
W85-04919 3D

WATER POLICY
Canadian Water Management: A One Armed Giant,
W85-04685 6A

WATER POLLOTION CONTROL
Acid Deposition Control, A Benefit-Cost Analysis: Its Prospects and Limits,
W85-04798 6B

WATER POLLUTION CONTROL
Pollution Control in the Humber Estuary,
W85-04453 5G

Research Related to Water Pollution Control in South Africa,
W85-04456 5D

Industrial Effluent Control in the Netherlands and Legislation in this Field in Some Other European Countries,
W85-04520 5G

Pollution Control Policies for the Tees Estuary,
W85-04525 5G

Pollution Management and the Tidal Thames,
W85-04527 5G

System of Practices for Preventing Water by Agricultural Chemicals,
W85-04619 5G

Acid Rain: Dousing Community Resources,
W85-04750 5F

Changes of Organic and Inorganic Nitrogen in a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Organische en Anorganische Stikstof van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04890 5G

Status Report on Abatement of Water Pollution from the Canadian Petroleum Refining Industry - 1980.
W85-04940 5D

WATER POLLUTION EFFECTS
Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies,
W85-04435 5C

Effect of Methylene Chloride on Respiration and Electron Transport System (ETS) Activity in Freshwater Sediment,
W85-04475 5C

Effects of Trichloroacetic Acid, a New Contaminant Found from Chlorinating Water with Organic Material, on Dragonfly Nymphs,
W85-04478 5C

Effects of Power Station Cooling Water Discharges on Aquatic Ecology,
W85-04507 5C

Assessment of Historical Change in Two Northern Minnesota Lakes,
W85-04602 5B

Some Remarks on the Ecology of Algae in Heated Waters (Uwagi o ekologii glonow w wodach podgrzanych),
W85-04609 5C

Confinement and Water Quality-Induced Stress in Largemouth Bass,
W85-04680 5C

Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

Effect of Some Heavy-metals on Glucose Assimilation in Polluted Waters,
W85-04705 5C

Evolution of the Community at a Station Exposed to Sewage (Marseille-Cortiou) (Evolution Du Peuplement D'une Station Soumise A Des Apports D'Eaux D'Egout (Marseille-Cortiou)),
W85-04709 5C

Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 1. Environmental Conditions,
W85-04710 5C

Copper Complexation and Toxicity to Daphnia in Natural Waters,
W85-04716 5C

Macroinvertebrates in a Sewage-Polluted Aquifer,
W85-04720 5C

WATER POLLUTION EFFECTS

Review of the Food and Drug Administration Risk Analysis for Polychlorinated Biphenyls in Fish,
W85-04775 5C

Ecoepidemiology - A Casuistic Discipline Describing Ecological Disturbances and Damages in Relation to Their Specific Causes: Exemplified by Chlorinated Phenols and Chlorophenoxy Acids,
W85-04777 5C

Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

PCB Resistance within Phytoplankton Populations in Polluted and Unpolluted Marine Environments,
W85-04864 5C

Simultaneous Exposure of English Sole (Parophrys vetulus) to Sediment-Associated Xenobiotics: Part 1 - Uptake and Disposition of 14C-Polychlorinated Biphenyls and 3H-Benzo(a)Pyrene,
W85-04870 5C

Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

Effects of Organic Pollutants on Methanogenesis, Sulfate Reduction and Carbon Dioxide Evolution in Salt Marsh Sediments,
W85-04872 5C

Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

Vascular Riffle Flora of Appalachian Streams: The Ecology and Effects of Acid Mine Drainage on Justicia americana (L.) Vahl,
W85-04884 5C

Comparative Survey of the Erpobdella octoculata (L.) Populations in the Afon Crafnant, N. Wales, Above and Below an Input of Zinc from Mine-Waste,
W85-04886 5C

Heavy Metals in the Bombay Harbour Area,
W85-04892 5C

WATER POLLUTION PREVENTION

Long-term Groundwater Protection with Plastic Linings (Langfristiger Grundwasserschutz mit Kunststoffdichtungsbahnen),
W85-04633 5G

WATER POLLUTION SOURCES

Regional River Sulfur Runoff,
W85-04481 5B

Determination of Trialkyl and Triaryl Phosphates in Environmental Samples,
W85-04497 5B

WATER POTENTIAL

Stomatal Responses to Leaf Water Potentials of Drip Irrigated Peach (Prunus persica),
W85-04746 2I

WATER QUALITY

Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

Variation of Water Quality Parameters in Meso- to Hypereutrophic Lakes,
W85-04536 2H

Effect of Agricultural Land Use on Ground-Water Quality in a Small Pennsylvania Watershed,
W85-04642 5B

Trends in Lake Rotorua Water Quality,
W85-04669 2H

Biomanipulation Experiment in Green Lake, Seattle, Washington,
W85-04671 5G

Possible Relationships Between Surface Water Chemistry and Aquatic Plants in the Northern Great Plains,
W85-04697 2H

Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality,
W85-04753 6B

Use of Bacteriological Indicators for Swimming Water Quality,
W85-04765 5A

Determination of Spreading of Nutritive Salts in Quasi-Stagnant Waters by Using Lithium (Chloride) as Tracer and Continuous Measurement of Water-Quality Parameters (Die Bestimmung von Ausbreitungsvorgangen von Nahrsalzen in quasi stehenden Gewassern unter Verwendung des Tracers Lithium (Chlorid) und die kontinuierliche Messung von Wasserguteparametern),
W85-04810 5A

Changes in the Oxygen Balance of a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Zuurstofbalans van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04889 5G

Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

Water Quality of the Colorado River System: Historical Trends in Concentration Load, and Mass Fraction of Inorganic Solutes,
W85-04942 2E

WATER QUALITY CONTROL

Development and Use of a Theoretical Mathematical Model for the Medway Estuary,
W85-04450 2L

Evaluation of Eutrophication Impact in Public Water Supply Reservoirs in East Anglia,
W85-04451 5C

Health and Amenity Aspects of Surface Waters,
W85-04457 5G

Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

Design and Operation of the Purification Lakes in the Ruhr Valley,
W85-04459 5G

Large-Scale Field Experiment in the Control of Eutrophication in the Norfolk Broads,
W85-04465 5G

Different Approach to Water Quality Sampling,
W85-04524 5A

Proposed Legal Framework for the Regulation of Drinking Water,
W85-04766 6E

Eutrophication Control and the Fallacy of Nitrogen Removal,
W85-04774 5G

Leaching of Tetrachloroethylene from Vinyl-Lined Pipe,
W85-04963 5F

WATER QUALITY MANAGEMENT

Groundwater Quality Protection: The Issue in Perspective,
W85-04683 5G

WATER QUALITY STANDARDS

Biological Considerations in the Setting of Quality Standards for the Tidal Thames,
W85-04509 5G

WATER RESOURCES DEVELOPMENT

Role of Watershed Management in Water Resources Development Planning - Need for Integrated Approach to Development of Catchment and Command of Irrigation Projects,
W85-04441 6B

River Basin Planning: Problems, Opportunities and Implications for Ontario Conservation Authorities,
W85-04572 6A

Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

Canadian Water Management: A One Armed Giant,
W85-04685 6A

Future of Hydropower in Brazil,
W85-04779 6B

Integrated Planning System for Hydro Development in Ecuador,
W85-04780 6A

Environmental Management Planning for Dams and Hydro Schemes.
W85-04784 6G

Large Hydropower Stations in China,
W85-04951 6B

WATER SAMPLING

Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

WATER SOURCES

D/H Ratios of Sap in Trees: Implications for Water Sources and Tree Ring D/H Ratios,
W85-04758 2I

WATER STORAGE

Linear Programming Model for the Control of Combined Sewer Systems with Off-Line Storage Facilities,
W85-04576 5G

WATER SUPPLY

Use of Icebergs to Supply Water (Die Verwendung von Eisbergen zur Wasserversorgung),
W85-04625 3B

Water Utility in the Nuclear Age,
W85-04773 5B

Water for the Flats.
W85-04811 4A

WATER TABLE

Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
W85-04727 2D

Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

WATER TEMPERATURE
Effect of Water Temperature Elevation on Incipient and Cumulative Fecundity of Batch-Spawning Tench, Tinca tinca (L.),
W85-04707 8I

WATER TREATMENT
Some Characteristics of Chemical Crystallization in Water Purification Process,
W85-04409 5F

Enhance Cooling-Water Reuse with Sidestream Softening,
W85-04469 5F

Optimization of Sand Recycle Rate in Mobile Bed Filtration,
W85-04663 5F

Causes of a Waterborne Giardiasis Outbreak,
W85-04830 5F

Removing Giardia Cysts with Slow Sand Filtration,
W85-04831 5F

Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

Removal of New Indicators by Coagulation and Filtration,
W85-04833 5F

Influence of Suspended Particle Size Distribution in Deep-Bed Filtration,
W85-04876 5F

Time Series Models for Treatment of Surface Waters,
W85-04965 5F

WATER TREATMENT FACILITIES
Study of Waterworks in the Mannheim/Heidelberg Urban Area Using the Example of the Rheinau RHE Waterworks (Wasserwerksbetriebe im Ballungsraum Mannheim/Heidelberg am Beispiel des RHE-Wasserwerkes Rheinau),
W85-04626 5F

Privatization Needs the Professional Approach,
W85-04954 6A

WATER USE
LGWRES - Life of Ground-Water Reserves,
W85-04643 4B

Peak Use Charge: An Equitable Approach to Charging for and/or Reducing Summer Peak Use,
W85-04687 6C

Water Conservation in the Northwest Territories - Public Education and Awareness Program,
W85-04920 3D

WATER USE INDEX
Lawn and Garden Watering Regulations: Conservation Through a Water Use Index,
W85-04695 3D

WATERLOGGING
Sensitivity of Stone Fruit Rootstocks to Waterlogging,
W85-04812 2I

Effects of Soil Waterlogging on the Energy Status and Distribution of Salix nigra and S. exigua (Salicaceae) in the Atchafalaya River Basin of Louisiana,
W85-04943 2I

WATERLOO
Managing Summer Lawn Irrigation Demands: A Water Use Index,
W85-04694 3D

Lawn and Garden Watering Regulations: Conservation Through a Water Use Index,
W85-04695 3D

WATERSHED MANAGEMENT
Role of Watershed Management in Water Resources Development Planning - Need for Integrated Approach to Development of Catchment and Command of Irrigation Projects,
W85-04441 6B

Controlling Erosion and Sedimentation in the Panama Canal Watershed,
W85-04442 4D

Economic/Institutional Issues in Sedimentation Management in Developing Countries,
W85-04443 4D

Management of Sediment in New South Wales, Australia,
W85-04444 4D

Physical and Economic Impacts of Sedimentation on Fishing Activities; Nam Pong Basin, Northeast Thailand,
W85-04448 5C

WATERSHEDS
River Basin Planning: Problems, Opportunities and Implications for Ontario Conservation Authorities,
W85-04572 6A

Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

WELLS
Ground-Water Contamination and Well Construction in Southeast Nebraska,
W85-04637 5B

WESER ESTUARY
Method to Measure Suspended Load Transports in Estuaries,
W85-04675 2L

WEST THORNTON
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

WETLANDS
Protozoan Colonization Rates and Trophic Status of Some Freshwater Wetland Lakes,
W85-04657 2H

Proposed Framework for Developing a Multidisciplinary Wetlands Valuation Model,
W85-04684 2L

Opportunity Costs of Preserving Coastal Wetlands: A Case Study of a Recreational Housing Development,
W85-04754 6B

WHITEFISH
Responses of Lake Whitefish (Coregonus clupeaformis) to Fertilization of Lake 226, the Experimental Lakes Area,
W85-04840 8I

WILLOWS
Effects of Soil Waterlogging on the Energy Status and Distribution of Salix nigra and S. exigua (Salicaceae) in the Atchafalaya River Basin of Louisiana,
W85-04943 2I

WIND EROSION
Prediction of Soil Erosion by Water and Wind for Various Fractions of Cover,
W85-04732 2J

WISCONSIN
Zooplankton Dynamics in Lake Mendota: Short-term Versus Long-term Changes,
W85-04897 2H

WUJIANG RIVER
Large Hydropower Stations in China,
W85-04951 6B

WYOMING
Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

YANGTZE RIVER
Large Hydropower Stations in China,
W85-04951 6B

YUGOSLAVIA
Model of Diatom Dynamics in the Epilimnion of Lake Jezero on the Island of Krk,
W85-04900 2H

Effects of Ecological Perturbations on Diatom Dynamics in the Model of Lake Jezero,
W85-04901 2H

ZALA RIVER
Extension of a Streamflow Time Series by Regression (Verlangerung einer Zeitreihe des Durchflusses mit Hilfe eines Regressionsmodells),
W85-04807 2E

ZERO SIDE YARD HOUSING
Zero Side Yard Housing, Acceptance and Stormwater Management Implications,
W85-04580 4A

ZINC
Simultaneous Determination of Zinc and Chromate in Cooling Water by Differential Pulse Polarography,
W85-04624 5A

Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

Comparative Survey of the Erpobdella octoculata (L.) Populations in the Afon Crafnant, N. Wales, Above and Below an Input of Zinc from Mine-Waste,
W85-04886 5C

ZOOPLANKTON
Zooplankton and its Grazing as Measures of Trophy in the Loosdrecht Lakes,
W85-04548 2H

Zooplankton Dynamics in Lake Mendota: Short-term Versus Long-term Changes,
W85-04897 2H

AUTHOR INDEX

ABE, T.
Inorganic Nutrients Occurring in the Oxygen-deficient Bottom Water of Osaka Bay,
W85-04606 2K

ABRAHAMSEN, H.
Efficiency of Liming in Acid, Humus-Influenced Lakes,
W85-04533 5G

ABRAM, F. S.
Biodegradability of Two Primary Alcohol Ethoxylate Nonionic Surfactants Under Practical Conditions, and the Toxicity of the Biodegradation Products to Rainbow Trout,
W85-04487 5D

ABRIOLA, L. M.
Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; I. Equation Development,
W85-04787 5B

Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; 2. Numerical Simulation,
W85-04788 5B

ACREMAN, J. C.
Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

ADMIRAAL, W.
Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

AGRAWAL, V. P.
Alachlor Toxicity to a Freshwater Teleost Clarias batrachus,
W85-04885 5C

AHLERT, R. C.
Anaerobic Treatment of Concentrated Industrial Wastewater,
W85-04877 5D

AHMED, S.
Mathematical Model for Reservoir Sedimentation Planning,
W85-04785 6A

AHRENS, V. D.
Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

AIKMAN, D. I.
Treatment of Ferruginous Ground Water from an Abandoned Colliery,
W85-04596 5D

AIM, R. B.
Optimization of Sand Recycle Rate in Mobile Bed Filtration,
W85-04663 5F

AISLABIE, J.
Effect of Effluent High in Chromium on Marine Sediment Aerobic Heterotrophic Bacteria,
W85-04869 5C

AJMAL, M.
Effects of a Textile Factory Effluent on Soil and Crop Plants,
W85-04945 5D

AL-SALIHI, S. B. S.
Sewage-Derived Bacteria Monitored in a Marine Water Column by Means of Captive Mussels,
W85-04868 5A

AL'TERMAN, D. Z.
Experience in the Operation of Hydraulic Structures and Equipment of Hydroelectric Stations,
W85-04423 8C

ALBERTIN, W.
Controlling Erosion and Sedimentation in the Panama Canal Watershed,
W85-04442 4D

ALEKSEEV, V. V.
Physical Model of the Aquatic Ecosystem,
W85-04850 2H

ALEXANDER, M.
Biodegradation of Organic Chemicals,
W85-04797 5B

ALLEN, D. H.
Dispersion Modeling of Multiple Sources Using the HP-41CV,
W85-04644 5B

ALLEN, J. D.
Quantification of Stream Drift,
W85-04842 2H

ALTNODER, J.
Study of Waterworks in the Mannheim/Heidelberg Urban Area Using the Example of the Rheinau RHE Waterworks (Wasserwerksbetriebe im Ballungsraum Mannheim/Heidelberg am Beispiel des RHE-Wasserwerkes Rheinau),
W85-04626 5F

ANDERBERG, K.
Acid Rain: Dousing Community Resources,
W85-04750 5F

ANDERSON, D. S.
Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

ANDERSON, R. S.
Present Techniques for 'In-Situ' Sewer Renovation,
W85-04518 8F

ANDERSSON, P.
Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

ANDREAE, M. O.
Geochemistry of Inorganic Germanium In Natural Waters,
W85-04482 2K

ANDREWS, M. J.
Biological Considerations in the Setting of Quality Standards for the Tidal Thames,
W85-04509 5G

ANGERMEIER, P. L.
Relationships Between Woody Debris and Fish Habitat in a Small Warmwater Stream,
W85-04679 2E

ARAD, A.
Brackish Groundwater as an Alternative Source of Cooling Water for Nuclear Power Plants in Israel,
W85-04599 4B

ARKHIPOV, G. A.
Consideration of Sediment Transport when Calculating Local Scour,
W85-04427 2J

ARMON, R.
Comparison of Current Methods of Poliovirus Concentration from Tap Water,
W85-04492 5F

ARMSTRONG, B.
Water Conservation in the Northwest Territories - Public Education and Awareness Program,
W85-04920 3D

ARSHENEVSKII, N. N.
Mathematical Modeling of Hydraulic Regimes in the Transition Between the Surge Tank and Conduits of a Hydroelectric Station,
W85-04419 8B

Optimization of Design Parameters of Complex Surge Tanks,
W85-04426 8A

ARVOLA, L.
Light Penetration and Some Related Characteristics in Small Forest Lakes in Southern Finland,
W85-04542 2H

ASMUSSEN, L. E.
Nutrient Budgets for Agricultural Watersheds in the Southeastern Coastal Plain,
W85-04826 6G

ATTA, S. A.
Distribution of Carbonates, Bicarbonates, and pH Values in Ground Water of the Nile Delta Region, Egypt,
W85-04638 2K

AUSTIN, A.
Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

BABICH, H.
Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies,
W85-04435 5C

BABIN, J.
Modelling Winter Oxygen Depletion Rates in Ice-Covered Temperate Zone Lakes in Canada,
W85-04843 2H

BABISH, J. G.
Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

BACHMANN, A.
Performance Characteristics of the Anaerobic Baffled Reactor,
W85-04495 5D

BACIC, S.
Some Characteristics of Chemical Crystallization in Water Purification Process,
W85-04409 5F

BADAWY, M. I.
Organochlorine Insecticides and PCBs in Water, Sediment, and Fish from the Mediterranean Sea,
W85-04473 5B

BADR, A. W.
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

BAI, L.
Role of Small Hydro in Rural Electrification,
W85-04949 6B

BAILEY, M. C.
Investigation into the Hydraulic Resources of a Lagoon in Portugal,
W85-04461 5G

BAILEY, R. H.
Human Modification of Molluscan Habitats in Little Creek Estuary, Virginia,
W85-04859 6G

BAIRD, R.
Doing a Job on Data,
W85-04651 7C

BAKER, J. L.
Runoff and Sediment Transport Within and From Small Agricultural Watersheds,
W85-04734 2J

BAKER, J. L.

Simulated Effects of Fertilizer Management on Nitrate Loss with Tile Drainage Water for Continuous Corn,
W85-04739 6G

BALANI, M. C.
Heavy Metals in the Bombay Harbour Area,
W85-04892 5C

BANASZAK, K. J.
Potential Effects on Ground Water of a Hypothetical Surface Coal Mine in Indiana,
W85-04418 4C

BANCROFT, K. C. C.
Arsenic Speciation in Soil-Pore Waters From Mineralized and Unmineralized Areas of South-West England,
W85-04662 2K

BANGERA, V. S.
Heavy Metals in the Bombay Harbour Area,
W85-04892 5C

BANOUB, M. W.
Effect of Some Heavy-metals on Glucose Assimilation in Polluted Waters,
W85-04705 5C

BARCELONA, M. J.
Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

BARCLAY, D. S.
Retrofitting Apartment Buildings To Reduce Costs and Water Demand,
W85-04690 3D

BARFIELD, B. J.
Chemical Flocculation for Suspended Solids Removal at Remote Mine Sites,
W85-04730 5D

Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

Sediment Detention Pond Model Using CSTRS Mixing Theory,
W85-04731 5E

BARICA, J.
Gas Supersaturation as a Cause of Early Spring Mortality of Stocked Trout,
W85-04844 2H

BARKER, J. F.
Migration and Attenuation of Selected Organics in a Sandy Aquifer - A Natural Gradient Experiment,
W85-04635 5B

BARNHISEL, R. I.
Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

BARRIE, L. A.
Spatial Distributions of Precipitation Acidity and Major Ion Wet Deposition in North America During 1980,
W85-04647 5B

BARTOS, J. M.
Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

BASKIN, D. E.
Unified Analysis of Thickening,
W85-04964 5E

BATIE, S. S.
Opportunity Costs of Preserving Coastal Wetlands: A Case Study of a Recreational Housing Development,
W85-04754 6B

BATIFOL, F. M.
Atmospheric Heavy Metals in High Altitude Surface Snows From Mont Blanc, French Alps,
W85-04501 5B

BAUGHEN, A. J.
Measurement of the Performance of Sewerage Systems and Associated Hydraulic Structures - Recent Developments,
W85-04511 5D

BAUTISTA, M. F.
Groundwater Source of Nitrate in Nearshore Marine Sediments,
W85-04616 5B

BAXTER, K. M.
Effects of the Recharge on Sewage Effluents Upon the Quality of Chalk Groundwater,
W85-04462 5C

BEARD, M. J.
Effects of the Recharge on Sewage Effluents Upon the Quality of Chalk Groundwater,
W85-04462 5C

BEARD, V. L.
Performance Characteristics of the Anaerobic Baffled Reactor,
W85-04495 5D

BEAUCHAMP, J. J.
Subsampling Program for the Estimation of Fish Impingement,
W85-04604 5C

BECKETT, P. H. T.
Availability to Plants of Phosphate in Sludges Precipitated from the Effluent from Sewage Treatment,
W85-04597 5E

Changes in the Extractabilities of the Heavy Metals in Water-Logged Sludge-Treated Soils,
W85-04514 5E

BEHAIRY, A. K. A.
Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 1. Environmental Conditions,
W85-04710 5C

Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 2. Nutrient Salts,
W85-04711 5C

BEJDA, A. J.
Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

BELLAMY, W. D.
Removing Giardia Cysts with Slow Sand Filtration,
W85-04831 5F

BEN AIM, R.
Influence of Suspended Particle Size Distribution in Deep-Bed Filtration,
W85-04876 5F

BEN-YOSEF, J.
PCBs, DDTs and Other Chlorinated Hydrocarbons in Marine Organisms from the Mediterranean Coast of Israel,
W85-04894 5B

BENES, P.
Migration and Speciation of Lead in a River System Heavily Polluted From a Smelter,
W85-04484 5B

BENFIELD, E. F.
Shredder Abundance and Leaf Breakdown in an Appalachian Mountain Stream,
W85-04899 2H

BENGTSON, R. L.
Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

BENGTSSON, B.-E.
Toxicity of Effluents from a TiO2 Plant to the Harpacticoid Copepod Nitocra spinipes Boeck,
W85-04866 5C

BENNER, J. R.
Utilities Delivery for the Indian and Inuit Affairs Program,
W85-04916 6B

BENNINGER, B. A.
Determining Extraneous Flows in Waste Water Systems,
W85-04689 8A

BENZ, L. C.
Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
W85-04727 2D

BERGEISEN, G. H.
Waterborne Outbreak of Hepatitis A in Meade County, Kentucky,
W85-04658 5C

BERGERSEN, E. P.
Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

BERGSTROM, B.
Toxicity of Effluents from a TiO2 Plant to the Harpacticoid Copepod Nitocra spinipes Boeck,
W85-04866 5C

BERLIN, V. V.
Mathematical Modeling of Hydraulic Regimes in the Transition Between the Surge Tank and Conduits of a Hydroelectric Station,
W85-04419 8B

BERLOIN, V. V.
Optimization of Design Parameters of Complex Surge Tanks,
W85-04426 8A

BERTHOU, F.
Determination of Polyaromatic Hydrocarbons in Scallops (Pecten maximus) by UV Fluorescence and HPLC Combined with UV and Fluorescence Detectors,
W85-04474 5B

BERUCHASHVILI, G. A.
Risk of Damage and Failure of Earth Dams,
W85-04430 8D

BEST, A. G.
A/O Process - Biological Treatment with Nutrient Removal,
W85-04594 5D

BEST, D. G.
Determination of COD by a Mercury-Free Open-Tube Method,
W85-04467 5A

BEST, E. P. H.
Macrophytes in the Loosdrecht Lakes: A Story of Their Decline in the Course of Eutrophication,
W85-04549 5C

BEST, G. A.
Treatment of Ferruginous Ground Water from an Abandoned Colliery,
W85-04596 5D

BEST, H. J.
Need for Chemical Phosphate Removal,
W85-04821 5D

BEVINS, R.
Destruction of Pathogens and Parasites in Sewage Sludge by Chemical Means,
W85-04592 5E

BHATNAGAR, R. M.
Simultaneous Determination of Zinc and Chromate in Cooling Water by Differential Pulse Polarography,
W85-04624 5A

BHATTARAI, K. K.
Dispersion Model for Waste Stabilization Ponds,
W85-04966 5D

BIANCHI, M.
Bioturbation and Microbial Activity,
W85-04704 2L

BINEY, C. A.
Chemical Survey of the Volta Estuary,
W85-04854 2L

BISOGNI, C. A.
Nitrate Contamination: Public Awareness,
W85-04828 5F

BISSON, M.
Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

BLAKAR, I. A.
Evaluation of Acidification Based on Former Colorimetric Determination of pH: The Effect of Indicators on pH in Poorly Buffered Water,
W85-04530 5A

BLANCHARD, R. D.
Use of a Permeation Sampler for Determination of Volatile Priority Pollutants,
W85-04960 5A

BLANNON, J. C.
Bacterial Colonization of Point-of-Use Water Treatment Devices,
W85-04834 5F

BLOUIN, A. C.
Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

BNINSKA, M.
Outdoor Recreation - A New Factor Disturbing Lake Ecosystems, as Exemplified by Lake Gim, Mazurian Lake District,
W85-04557 5C

BODENNEC, G.
Determination of Polyaromatic Hydrocarbons in Scallops (Pecten maximus) by UV Fluorescence and HPLC Combined with UV and Fluorescence Detectors,
W85-04474 5B

BOERS, P. C. M.
Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

BOISON, P. J.
Sediment Storage and Terrace Formation in Coyote Gulch Basin, South-Central Utah,
W85-04646 2J

BONGERS, J. W. T.
Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

BONNER, F. T.
Nitrogen-Isotope Ratios of Nitrate in Ground Water Under Fertilized Fields, Long Island, New York,
W85-04641 5B

BORG, H.
Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

BORGMANN, U.
Copper Complexation and Toxicity to Daphnia in Natural Waters,
W85-04716 5C

BORMANN, F. H.
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

BOTHA, G. R.
Research Related to Water Pollution Control in South Africa,
W85-04456 5D

BOUGIE, R.
Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

BOUTRON, C. F.
Atmospheric Heavy Metals in High Altitude Surface Snows From Mont Blanc, French Alps,
W85-04501 5B

BOUWMAN, L. A.
Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

BOWMER, K. H.
Detoxification of Effluents in a Macrophyte Treatment System,
W85-04489 5D

BOX, M. H.
Water Reclamation and River Management in the Tame Basin,
W85-04460 5G

BOYD, J. N.
Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

BRADLEY, R. M.
BOD Removal Efficiencies in Two Stabilization Lagoons in Series in Malaysia,
W85-04515 5D

BRADY, J. A.
Pollution Control Policies for the Tees Estuary,
W85-04525 5G

BRAIDECH, T. E.
Causes of a Waterborne Giardiasis Outbreak,
W85-04830 5F

BRAND, G. W.
Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

BREMEN, W. M.
Oxidation of Cyanides in Industrial Wastewaters by Ozone,
W85-04881 5D

BRINDLEY, P.
Changes in the Extractabilities of the Heavy Metals in Water-Logged Sludge-Treated Soils,
W85-04514 5E

BRINKHURST, R. O.
Comparative Study of Respiration Rates of Some Aquatic Oligochaetes in Relation to Sublethal Stress,
W85-04905 5C

BRO-RASMUSSEN, F.
Ecoepidemiology - A Casuistic Discipline Describing Ecological Disturbances and Damages in Relation to Their Specific Causes: Exemplified by Chlorinated Phenols and Chlorophenoxy Acids,
W85-04777 5C

BROCH, E.
Unlined High Pressure Tunnels in Areas of Complex Topography,
W85-04412 8A

BROCK, T. D.
Zooplankton Dynamics in Lake Mendota: Short-term Versus Long-term Changes,
W85-04897 2H

BROECKER, W. S.
D/H Ratios of Sap in Trees: Implications for Water Sources and Tree Ring D/H Ratios,
W85-04758 2I

BROOKS, A. S.
Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

BROUWER, M.
Trace Metal-Binding Proteins in Marine Molluscs and Crustaceans,
W85-04873 5C

BROWN, M. P.
Different Approach to Water Quality Sampling,
W85-04524 5A

BROWN, S.
Case Study, Potable Water Reservoir, Tuktoyaktuk, Northwest Territories,
W85-04927 6A

BROWN, V. M.
Biodegradability of Two Primary Alcohol Ethoxylate Nonionic Surfactants Under Practical Conditions, and the Toxicity of the Biodegradation Products to Rainbow Trout,
W85-04487 5D

BRUGGERS, D. E.
Underground Utilities in Barrow, Alaska,
W85-04925 6A

BRUSCHIN, J.
Hydraulic Modelling at the Piedra del Aguila Dam,
W85-04781 8B

BUCHANAN, J. A.
Control of Suspended Solids in Open Cooling Water Systems,
W85-04820 5F

BUCHANAN, S.
Pure O2 Retrofit Doubles Plant's Capacity,
W85-04953 5D

BUCHLEITER, G. W.
Integrated Water-Energy Management System for Center Pivot Irrigation: Functional Requirements,
W85-04742 7C

Integrated Water-Energy Management System for Center Pivot Irrigation: Implementation,
W85-04743 7C

BUCHS, A.
5-alpha(H)-Cholestan-3-alpha-ol in Sediments: Characterization and Geochemical Significance,
W85-04759 2K

BUFFLE, J.
Importance of Speciation Methods in Analytical Control of Water Treatment Processes With Application to Fluoride Removal From Waste Waters,
W85-04485 5A

BULTHUIS, D. A.
Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

BUTLER, E. C. V.
Application of Ion-Exchange Chromatography with an Ion-Selective Electrode Detector to Iodine Determination in Natural Waters,
W85-04654 5A

BYRD, J. T.
Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

CAIRNS, J. JR.
Protozoan Colonization Rates and Trophic Status of Some Freshwater Wetland Lakes,
W85-04657 2H

CALABRESE, E. J.
Effects of Trichloroacetic Acid, a New Contaminant Found from Chlorinating Water with Organic Material, on Dragonfly Nymphs,
W85-04478 5C

CALCUTT, T.
Sewage Sludge Treatment and Disposal - The Way Ahead,
W85-04455 5E

CAMERON, J. J.
Economic Analysis of Water and Sanitation Alternatives for Communities in Northern Canada,
W85-04917 6A

CAMPBELL, P. G. C.
Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

CAPONE, D. G.
Effects of Organic Pollutants on Methanogenesis, Sulfate Reduction and Carbon Dioxide Evolution in Salt Marsh Sediments,
W85-04872 5C

Groundwater Source of Nitrate in Nearshore Marine Sediments,
W85-04616 5B

CAPPENBERG, T. E.
Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

Loosdrecht Lakes Restoration Project: Hydrology and Physico-Chemical Characteristics of the Lakes,
W85-04545 2H

Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

CAPPON, C. J.
Content and Chemical Form of Mercury and Selenium in Lake Ontario Salmon and Trout,
W85-04717 5C

CARIGNAN, R.
Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides,
W85-04757 5B

CARLEN, W. L.
Movement of Water in a Plinthic Paleudult Using a Bromide Tracer,
W85-04957 2G

CARLSON, T. N.
Analysis of Precipitation Collected on a Sequential Basis,
W85-04505 5B

CARMICHAEL, G. J.
Confinement and Water Quality-Induced Stress in Largemouth Bass,
W85-04680 5C

CARTER, C. E.
Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

Hydraulic Conductivity Measured Electronically in an Auger Hole,
W85-04740 2G

CASTELLA, E.
Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

CAZELLES, B.
Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

CEBALT, F.
Thermal Treatment 'Energizes' San Mateo Sludge,
W85-04649 5E

CEJCHANOVA, M.
Migration and Speciation of Lead in a River System Heavily Polluted From a Smelter,
W85-04484 5B

CERUTTI, J. L.
Underground Utilities in Barrow, Alaska,
W85-04925 6A

CHANASYK, D. S.
Interflow Model: I. Model Development,
W85-04577 2A

Interflow Model: II. Model Validation,
W85-04579 2A

CHAO, P. C.
Mathematical Model for Reservoir Sedimentation Planning,
W85-04785 6A

CHAPMAN, P. M.
Comparative Study of Respiration Rates of Some Aquatic Oligochaetes in Relation to Sublethal Stress,
W85-04905 5C

CHARLTON, C. C.
Copper Complexation and Toxicity to Daphnia in Natural Waters,
W85-04716 5C

CHEPAIKIN, G. A.
High-Head Spillway with Swirling of the Flow in the Outlet Section,
W85-04420 8A

CHILSON, G.
Low-Head Hydropower for Local Use,
W85-04620 6B

CHOJNACKI, J. M.
Effect of Anthropogenous Changes of Water Conditions on the Vegetation in the Forest Reserve Las Bielanski in Warsaw (Wplyw antropogennych zmian stosunkow wodnych na roslinnosc rezerwatu Las Bielanski w Warszawie),
W85-04610 4C

CHOUDHURY, G. R.
Managment of Sedimentation in Bangladesh,
W85-04440 2J

CHUDOBA, J.
Quantitative Estimation in COD Units of Refractory Organic Compounds Produced by Activated Sludge Microorganisms,
W85-04486 5D

CHURCH, T. M.
Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

CLARK, D.
Case Study, Potable Water Reservoir, Tuktoyaktuk, Northwest Territories,
W85-04927 6A

CLOUGH, G. F. G.
Practical Aspects of Energy Saving in Wastewater Disposal,
W85-04595 5D

CLOW, G. D.
Thickness of Ice on Perennially Frozen Lakes,
W85-04883 2C

COATES, M.
Scheme for the Direct Analysis of Organics in the Environment by Tandem Mass Spectrometry,
W85-04656 5A

COCKBURN, A. G.
Biological Considerations in the Setting of Quality Standards for the Tidal Thames,
W85-04509 5G

Pollution Management and the Tidal Thames,
W85-04527 5G

COHEN, Y.
Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel,
W85-04863 5B

COLER, R. A.
Effects of Trichloroacetic Acid, a New Contaminant Found from Chlorinating Water with Organic Material, on Dragonfly Nymphs,
W85-04478 5C

COLLINS, T. M.
Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

COMBA, M. E.
Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

COOK, E. R.
D/H Ratios of Sap in Trees: Implications for Water Sources and Tree Ring D/H Ratios,
W85-04758 2I

COOK, J. A.
Fate of Contaminants During Treatment of H-Coal Process Wastewaters,
W85-04878 5D

CORBO, P.
Anaerobic Treatment of Concentrated Industrial Wastewater,
W85-04877 5D

CORREA, M.
Effects of Trichloroacetic Acid, a New Contaminant Found from Chlorinating Water with Organic Material, on Dragonfly Nymphs,
W85-04478 5C

COSBY, B. J.
Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry,
W85-04792 5C

COSPER, E. M.
PCB Resistance within Phytoplankton Populations in Polluted and Unpolluted Marine Environments,
W85-04864 5C

COTE, M. G.
Subchronic Effects of a Mixture of 'Persistent' Chemicals Found in the Great Lakes,
W85-04479 5C

COUILLARD, D.
PCBs and Organochlorine Pesticides in the St. Lawrence System (BPC ET Pesticides Organochlores Dans Le Systeme Saint-Laurent),
W85-04581 5B

COWIE, B.
Analysis of Changes in the Invertebrate Community Along a Southern New Zealand Montane Stream,
W85-04724 2H

CREE, C. N. L.
Resurrection of Deighton Sewage Treatment Works,
W85-04512 5D

CROCKER, T. D.
Acid Deposition Control, A Benefit-Cost Analysis: Its Prospects and Limits,
W85-04798 6B

CROMARTIE, E.
Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas,
W85-04480 5B

CSEH, T.
Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

CULP, J. M.
Responses of Benthic Macroinvertebrate Species to Manipulation of Interstitial Detritus in Carnation Creek, British Columbia,
W85-04841 2H

CUTSHALL, N. H.
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

CZAKO, I.
Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

D'ANGLEJAN, B.
Near Bottom Variations of Turbidity in the St. Lawrence Estuary,
W85-04677 2L

DAGAN, G.
Stochastic Modeling of Groundwater Flow by Unconditional and Conditional Probabilities: The Inverse Problem,
W85-04793 2F

DAHN, C. N.
Composition and Possible Origin of Detrital Material in Streams,
W85-04827 2J

DAIGOBO, S.
Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

DALE, H. M.
Aquatic Macrophyte Vegetation of an Isolated Island Lake Adjacent to Lake Nipigon, Ontario: A Comparative Study After a Fifty-six Year Interval,
W85-04661 2H

DALRYMPLE, R. J.
Lake Ontario Oxygen Model. 1. Model Development and Application,
W85-04801 2H

DAME, R. F.
Oyster Reefs as Processors of Estuarine Materials,
W85-04483 2L

DANIEL, T. C.
Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

DANOS, S. C.
Retrieval of Material from the Surface Microlayer with Screen and Plate Samplers and its Implications for Partitioning of Material within the Microlayer,
W85-04895 5A

DAUMAS, R.
Bioturbation and Microbial Activity,
W85-04704 2L

DAVEY, S.
Revolutionary Experiments Turn Sludge into Fuel,
W85-04771 5E

DAVIES, B. R.
Studies on the Zoobenthos of Some Southern Cape Coastal Lakes. Spatial and Temporal Changes in the Benthos of Swartvlei, South Africa, in Relation to Changes in the Submerged Littoral Macrophyte Community,
W85-04818 2H

DAVIES-COLLEY, R. J.
Factors Affecting Clarity of New Zealand Lakes,
W85-04670 2H

DAVIES, R. W.
Responses of Benthic Macroinvertebrate Species to Manipulation of Interstitial Detritus in Carnation Creek, British Columbia,
W85-04841 2H

DAVIES, T. D.
Rainborne SO2, Precipitation pH and Airborne SO2 Over Short Sampling Times Throughout Individual Events,
W85-04500 5B

DAVIS, K. B.
Confinement and Water Quality-Induced Stress in Largemouth Bass,
W85-04680 5C

DAVIS, R. B.
Methods of pH Calibration of Sedimentary Diatom Remains for Reconstructing History of pH in Lakes,
W85-04725 5C

DAWES, N. J.
Developments in Materials and Design Techniques for Sewerage Systems,
W85-04517 8A

DAY, K. E.
Dissipation of Permethrin in Limnocorrals,
W85-04838 5B

DE BOER, T.
Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

DE CASSERES, K. E.
Determination of COD by a Mercury-Free Open-Tube Method,
W85-04467 5A

DE HANN, H.
Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

DE LACERDA, L. D.
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

DE PENA, R. G.
Analysis of Precipitation Collected on a Sequential Basis,
W85-04505 5B

DE ROOIJ, N. M.
Modelling Eutrophication in Shallow Dutch Lakes,
W85-04551 5C

DE SMET, S. J. M.
Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04898 5A

DE VRIES, D.
Macrophytes in the Loosdrecht Lakes: A Story of Their Decline in the Course of Eutrophication,
W85-04549 5C

DE VRIES, P. J. R.
Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04898 5A

DEEGAN, L. A.
Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

DELEON, I. R.
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

DELNORE, V. E.
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

DEMOND, A. H.
Leaching of Tetrachloroethylene from Vinyl-Lined Pipe,
W85-04963 5F

DENG, B.
Small Hydro in China: Progress and Prospects,
W85-04947 6B

DENISEGER, J.
Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

DICKEY, E. C.
Tillage Influences on Erosion During Furrow Irrigation,
W85-04749 4C

DIGERNES, I.
Evaluation of Acidification Based on Former Colorimetric Determination of pH: The Effect of Indicators on pH in Poorly Buffered Water,
W85-04530 5A

DILLON, C. R.
Quiescence, Growth and Senescence of Egeria densa in Lake Marion,
W85-04858 2H

DIONIGI, C. P.
Effects of Soil Waterlogging on the Energy Status and Distribution of Salix nigra and S. exigua (Salicaceae) in the Atchafalaya River Basin of Louisiana,
W85-04943 2I

DISCHEL, R. S.
Factors Influencing Impingement of Fish by Lake Ontario Power Plants,
W85-04713 8I

DIXON, D. R.
Embryo Abnormalities in the Periwinkle, Littorina 'saxatilis', as Indicators of Stress in Polluted Marine Environments,
W85-04893 5A

DMITRUKHIN, A. F.
Experience in the Operation of Hydraulic Structures and Equipment of Hydroelectric Stations,
W85-04423 8C

DOERING, E. J.
Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
W85-04727 2D

DOMOKOS, M.
Extension of a Streamflow Time Series by Regression (Verlangerung einer Zeitreihe des Durchflusses mit Hilfe eines Regressionsmodells),
W85-04807 2E

DONCHENKO, E. G.
High-Head Spillway with Swirling of the Flow in the Outlet Section,
W85-04420 8A

DOTY, C. W.
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

DOVEY, H. M.
Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

DOWNES, M. T.
Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

DRABKIN, M.
Wastewater Treatment Systems for Synthetic Fuels Plants Based on Peat and Oil Shale,
W85-04880 5D

DREISZIGER, N. F.
International Water Management in Canadian-American Relations, 1894-1907,
W85-04588 6E

DRUMMOND, C. J.
Fate of Contaminants During Treatment of H-Coal Process Wastewaters,
W85-04878 5D

DUCHON, K.
Pure O2 Retrofit Doubles Plant's Capacity,
W85-04953 5D

DUFFNER, R. M.
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

DUKE, H. R.
Integrated Water-Energy Management System for Center Pivot Irrigation: Functional Requirements,
W85-04742 7C

Integrated Water-Energy Management System for Center Pivot Irrigation: Implementation,
W85-04743 7C

DUMOUCHEL, A.
Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

DUNSTAN, E. R.
Fly Ash and Fly Ash Concrete,
W85-04936 8F

Parker Dam Concrete Core Investigations,
W85-04935 8F

DUPONT, R.
Increasing Interest of Public Electricity Suppliers in Micro Power Plants (Aufleben kleiner Wasserkrafte auch beim offentlichen Elektrizitatsversorgungsunternehmen),
W85-04628 6C

DUSSART, G. B. J.
Effects of Motorway Run-Off on the Ecology of Stream Algae,
W85-04466 5C

DUTTON, A. R.
Brackish Water in Unsaturated Confining Beds at a Texas Lignite Mine,
W85-04639 2F

EADON, A. R.
Measurement of the Performance of Sewerage Systems and Associated Hydraulic Structures - Recent Developments,
W85-04511 5D

EASTER, K. W.
Proposed Framework for Developing a Multidisciplinary Wetlands Valuation Model,
W85-04684 2L

EATON, J. S.
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

ECHELMEYER, K. A.
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

ECKARD, J. H.
Convert the Brook on Your Farm to Electric Current,
W85-04813 8C

EDWARD, D. G.
Proposed Legal Framework for the Regulation of Drinking Water,
W85-04766 6E

EISENBERG, M.
Organochlorine Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04437 5B

Trace Metal Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04436 5B

EISENHAUER, D. E.
Tillage Influences on Erosion During Furrow Irrigation,
W85-04749 4C

EL-DIB, M. A.
Organochlorine Insecticides and PCBs in Water, Sediment, and Fish from the Mediterranean Sea,
W85-04473 5B

EL GHANDOUR, M. F. M.
Distribution of Carbonates, Bicarbonates, and pH Values in Ground Water of the Nile Delta Region, Egypt,
W85-04638 2K

ELFIMOV, V. I.
Kinematic Structure of Flow in a Trapezoidal Channel,
W85-04421 8B

ELLIS, H.
Zero Side Yard Housing, Acceptance and Stormwater Management Implications,
W85-04580 4A

ELOFF, J. N.
Specific Ultraviolet Absorbance Band of Microcystis aeruginosa Toxins,
W85-04816 5A

ELORANTA, V. A.
Comparison of the Selenastrum Bottle Test and the Natural Phytoplankton Assay in Algal Toxicity Tests,
W85-04615 5A

ENGEL, D. W.
Trace Metal-Binding Proteins in Marine Molluscs and Crustaceans,
W85-04873 5C

ENGELBRECHT, R. S.
Removal of New Indicators by Coagulation and Filtration,
W85-04833 5F

ENGELEN, G. B.
Loosdrecht Lakes Restoration Project, an Introduction,
W85-04544 2H

Loosdrecht Lakes Restoration Project: Hydrology and Physico-Chemical Characteristics of the Lakes,
W85-04545 2H

ENGELHARDT, H.
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

EPP, D. J.
Importance of Sample Discrimination in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality,
W85-04753 6B

ESTEP, K. W.
Retrieval of Material from the Surface Microlayer with Screen and Plate Samplers and its Implications for Partitioning of Material within the Microlayer,
W85-04895 5A

ETTE, A. I. I.
Comparative Studies of NO3- Concentrations in Some Tropical Rains,
W85-04506 5B

EXNER, M. E.
Ground-Water Contamination and Well Construction in Southeast Nebraska,
W85-04637 5B

FABRE, M.
Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

FAHEY, T. J.
Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

FANG, Z.
Determination of Trace Amounts of Heavy Metals in Waters by a Flow-Injection System Including Ion-Exchange Preconcentration and Flame Atomic Absorption Spectrometric Detection,
W85-04653 5A

FARRELL, M. A.
Comparative Study of Respiration Rates of Some Aquatic Oligochaetes in Relation to Sublethal Stress,
W85-04905 5C

FEELEY, T. J. III
Fate of Contaminants During Treatment of H-Coal Process Wastewaters,
W85-04878 5D

FERNANDEZ, D. F.
Uribante-Doradas Hydro Development in Venezuela,
W85-04783 8A

FERRARIO, J. B.
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

FESSENDEN-RADEN, J.
Nitrate Contamination: Public Awareness,
W85-04828 5F

FIELD, J. A.
Comparison of Field- and Laboratory-Measured and Predicted Hydraulic Properties of a Soil with Macropores,
W85-04617 2G

FISHER, N. S.
Measurement of Particulate Association of Americium in Freshwater,
W85-04491 5A

FISZMAN, M.
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

FLAXMAN, E. W.
Developments in Materials and Design Techniques for Sewerage Systems,
W85-04517 8A

FLINT, R. W.
Phytoplankton Production in the Corpus Christi Bay Estuary,
W85-04432 2L

FLIPSE JR, W. J.
Nitrogen-Isotope Ratios of Nitrate in Ground Water Under Fertilized Fields, Long Island, New York,
W85-04641 5B

FONTVIEILLE, D.
Occurrence of DNA in River Sediment: Its Meaning and Relations With Benthos Respiration, Organic Load and Macroinvertebrates Biomass,
W85-04699 5C

FORD, G. S.
Nutrient Removal Trials and Bioassay Evaluation at Budds Farm Sewage-Treatment Works, Havant,
W85-04526 5D

FORSBERG, B. R.
Nutrient Processing in Amazon Floodplain Lakes,
W85-04571 2K

FORSBERG, C.
Variation of Water Quality Parameters in Meso-to Hypereutrophic Lakes,
W85-04536 2H

FORTNER, A. R.
Simultaneous Accumulations of Naphthalene, a PCB Mixture, and Benzo(a)pyrene, by the Oyster, Crassostrea virginica,
W85-04477 5B

FRANKEL, I.
Wastewater Treatment Systems for Synthetic Fuels Plants Based on Peat and Oil Shale,
W85-04880 5D

FRANKLIN, S. E.
Small Format, Hand Held Helicopter Based Photography for Monitoring Industrial Water Effluent Plumes,
W85-04586 7B

FRASER, J. A. L.
Tip Leachate Treatment Using Hydrogen Peroxide,
W85-04522 5D

FRENCH, V.
Let the Seas Do the Disposal,
W85-04648 5E

FRINDT, E. S.
Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

FRIOCOURT, M. P.
Determination of Polyaromatic Hydrocarbons in Scallops (Pecten maximus) by UV Fluorescence and HPLC Combined with UV and Fluorescence Detectors,
W85-04474 5B

FROELICH, P. N.
Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

Geochemistry of Inorganic Germanium In Natural Waters,
W85-04482 2K

FRY, B.
delta 13C Measurements as Indicators of Carbon Flow in Marine and Freshwater Ecosystems,
W85-04431 2K

FRY, R. H.
Prediction and Control of Ground Movement Associated with Trench Excavation,
W85-04516 8D

FRYER, B.
Optimization of Coleshill Activated-Sludge Plant Operating Conditions,
W85-04590 5D

FUJISAWA, K.
Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

FUKUSHIMA, M.
Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

FUNK, W. H.
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

FURCH, K.
Seasonal Variation of the Major Cation Content of the Varzea-Lake Lago Camaleao, Middle Amazon, Brazil, in 1981 and 1982,
W85-04570 2H

GAETO, T. A.
Stewart Mountain Dam Concrete Core Analysis - 1983,
W85-04938 8A

GAHNSTROM, G.
Short-term Effects of Liming on Sediment Oxygen Uptake in an Acid lake,
W85-04537 5G

GALLOWAY, J. N.
Composition of Precipitation on Amsterdam Island, Indian Ocean,
W85-04503 5B

Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry,
W85-04792 5C

Organic Acidity in Precipitation of North America,
W85-04499 5B

GARAVAGLIA, C.
Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

GARDNER, R. L.
Effects of Electricity Rates and Rate Structures on Pump Irrigation: An Eastern Colorado Case Study,
W85-04752 3F

GARSKE, E. E.
Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

GARTON, C. E.
Aquatic Macrophyte Vegetation of an Isolated Island Lake Adjacent to Lake Nipigon, Ontario: A Comparative Study After a Fifty-six Year Interval,
W85-04661 2H

GASCOINE, I. S.
Development and Use of a Theoretical Mathematical Model for the Medway Estuary,
W85-04450 2L

GAUDRY, A.
Composition of Precipitation on Amsterdam Island, Indian Ocean,
W85-04503 5B

GAUSS, J. D.
Acute Toxicity of Copper to Three Life Stages of Chrionomus tentans as Affected by Water Hardness-Alkalinity,
W85-04946 5C

GELDREICH, E. E.
Bacterial Colonization of Point-of-Use Water Treatment Devices,
W85-04834 5F

GERSHEY, R. M.
Application of Ion-Exchange Chromatography with an Ion-Selective Electrode Detector to Iodine Determination in Natural Waters,
W85-04654 5A

GETSINGER, K. D.
Quiescence, Growth and Senescence of Egeria densa in Lake Marion,
W85-04858 2H

GHIORSE, W. C.
Determination of Microbial Cell Numbers in Subsurface Samples,
W85-04636 5A

GIBBONS, H. L.
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

GICHURU, M.
Saline Irrigation Water: Effects on Soil Chemical and Physical Properties,
W85-04618 3C

GILLEY, J. R.
Sprinkler Droplet Size Distribution Estimation from Single Leg Test Data,
W85-04745 8C

GIRALDEZ, J. V.
Infiltration in Swelling Soils,
W85-04790 2G

GLASSMAN, C. A.
Composition and Possible Origin of Detrital Material in Streams,
W85-04827 2J

GOAD, J. A.
Biomanipulation Experiment in Green Lake, Seattle, Washington,
W85-04671 5G

GOCKE, K.
Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance,
W85-04907 2L

GODFREE, A. F.
Destruction of Pathogens and Parasites in Sewage Sludge by Chemical Means,
W85-04592 5E

GOEL, K. A.
Alachlor Toxicity to a Freshwater Teleost Clarias batrachus,
W85-04885 5C

GOEL, P. K.
Influence of Water Hyacinth Cover on the Physico-Chemical Characteristics of Water and Phytoplankton Composition in a Reservoir near Jaipur (India),
W85-04913 5C

GOGOBERIDZE, M. I.
Risk of Damage and Failure of Earth Dams,
W85-04430 8D

GOLACHOWSKA, J.
Phosphorus in the Bottom Sediments of Some Lakes of the World,
W85-04612 2H

GONANO, L. P.
Long-Term Prestress in Concrete-Lined Pressure Tunnels,
W85-04414 8F

GONCALVES, M. DE L. S.
Voltammetric Methods for Distinguishing between Dissolved and Particulate Metal Ion Concentrations in the Presence of Hydrous Oxides. A Case Study on Lead (II),
W85-04800 5A

GONS, H. J.
Seston-Epipelon Interrelationships in the Shallow Eutrophic Loosdrecht Lakes (The Netherlands),
W85-04547 2H

GOPAL, B.
Comparison of Leaching Losses from Decomposing Litter of the Terrestrial and Marsh Plants on Land and in Water,
W85-04553 2L

Influence of Water Hyacinth Cover on the Physico-Chemical Characteristics of Water and Phytoplankton Composition in a Reservoir near Jaipur (India),
W85-04913 5C

GOPHEN, M.
T2-Coliphage Uptake By Mosquito Larvae,
W85-04493 5D

GOSSELINK, J. G.
Vegetation and Primary Production in a Floating Freshwater Marsh in Louisiana,
W85-04855 2L

GOWDA, T. P. H.
Use of Bacteriological Indicators for Swimming Water Quality,
W85-04765 5A

GREEN, H. S.
Fluid Transport Processes in Upper Spencer Gulf,
W85-04762 2L

GREEN, M. B.
Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

GREENE, L. A.
Evaluation of Eutrophication Impact in Public Water Supply Reservoirs in East Anglia,
W85-04451 5C

GREGORY, J. M.
Prediction of Soil Erosion by Water and Wind for Various Fractions of Cover,
W85-04732 2J

GRIDLEY, N. C.
Water Use Reduction Through Metering Could Provide Significant Economic Benefits to Inuvik, N.W.T.,
W85-04919 3D

GRIFFIN, M. L.
Chemical Flocculation for Suspended Solids Removal at Remote Mine Sites,
W85-04730 5D

GRIFFITH, F. P. JR.
Peak Use Charge: An Equitable Approach to Charging for and/or Reducing Summer Peak Use,
W85-04687 6C

GRIMA, A. P.
Apples and Oranges: Toward a Critique of Public Participation in Great Lakes Decisions,
W85-04573 6A

Empirical Basis for Municipal Water Rates Modification,
W85-04688 3D

GRIMES, L. W.
Irrigation of Swine Lagoon Effluent onto Pine and Hardwood Forests,
W85-04741 5D

GROTERUD, O.
Conceptual Model of Lake Acidification,
W85-04531 5C

GRYGIER, J. C.
Algorithms for Optimizing Hydropower System Operation,
W85-04786 4A

GULACAR, F. O.
5-alpha(H)-Cholestan-3-alpha-ol in Sediments: Characterization and Geochemical Significance,
W85-04759 2K

GULATI, R. D.
Zooplankton and its Grazing as Measures of Trophy in the Loosdrecht Lakes,
W85-04548 2H

GUNN, R. J. M.
Biology of Brachycentrus subnubilus Curtis (Trichoptera) in the River Frome, Dorset,
W85-04887 2H

GUPTA, S. K.
Nitrogenous Wastewater Treatment by Activated Algae,
W85-04967 5D

GUROL, M. D.
Oxidation of Cyanides in Industrial Wastewaters by Ozone,
W85-04881 5D

GUSEV, A. A.
Discontinuous Wave on Stretches of an Abrupt Expansion of a Canal,
W85-04424 8B

GUTTMAN-BASS, N.
Comparison of Current Methods of Poliovirus Concentration from Tap Water,
W85-04492 5F

GVILIYA, M. E.
Risk of Damage and Failure of Earth Dams,
W85-04430 8D

HAAS, C. N.
Removal of New Indicators by Coagulation and Filtration,
W85-04833 5F

HAERDI, W.
Importance of Speciation Methods in Analytical Control of Water Treatment Processes With Application to Fluoride Removal From Waste Waters,
W85-04485 5A

HAGENAARS, C. P. M. M.
Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem,
W85-04703 2H

HAGER, W. H.
Reservoir Storage Equation Experimentally Verified,
W85-04416 2E

HAHN, H. H.
Comparison of Dynamic Flow Routing Methods for Urban Drainage Systems (Vergleich hydrodynamischer Berechnungsansatze zur Abfluber-mittlung in Kanalnetzen),
W85-04627 8B

HALES, J. H.
Spatial Distributions of Precipitation Acidity and Major Ion Wet Deposition in North America During 1980,
W85-04647 5B

HALL, C. W.
Groundwater Quality Protection: The Issue in Perspective,
W85-04683 5G

HALTTUNEN-KEYRILAINEN, L.
Comparison of the Selenastrum Bottle Test and the Natural Phytoplankton Assay in Algal Toxicity Tests,
W85-04615 5A

HALVERSON, B.
Hydraulic Conductivity Measured Electronically in an Auger Hole,
W85-04740 2G

HALVERSON, B. E.
Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

HAMBRICK, G. A.
Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

Geochemistry of Inorganic Germanium In Natural Waters,
W85-04482 2K

HAMLETT, J. M.
Runoff and Sediment Transport Within and From Small Agricultural Watersheds,
W85-04734 2J

HAMPTON, G. J.
Determination of Microbial Cell Numbers in Subsurface Samples,
W85-04636 5A

HANDLIN, D. L.
Irrigation of Swine Lagoon Effluent onto Pine and Hardwood Forests,
W85-04741 5D

HANSON, B. R.
Irrigation Scheduling Under Saline High Water Tables,
W85-04744 3F

HANSON, C. L.
Estimating the Parameters of a Cube Root Normal Distribution from Reduced Sample Data,
W85-04796 2B

HANTKE, H.
Use of Icebergs to Supply Water (Die Verwendung von Eisbergen zur Wasserversorgung),
W85-04625 3B

HARBISON, P.
Regional Variation in the Distribution of Trace Metals in Modern Intertidal Sediments of Northern Spencer Gulf, South Australia,
W85-04764 5B

HARDJOWITJITRO, H.
Watershed Rehabilitation Program Related to the Management of River and Reservoir Sedimentation in Indonesia,
W85-04438 4D

HARDY, J. K.
Use of a Permeation Sampler for Determination of Volatile Priority Pollutants,
W85-04960 5A

HARGIS, J. R.
Assessment of Historical Change in Two Northern Minnesota Lakes,
W85-04602 5B

HARKNESS, N.
Problems Associated with the Disposal of Trade Effluent to Sewers - Charging and Control,
W85-04463 5E

HARPER, D.
Recent Changes in the Ecology of Lake Naivasha, Kenya,
W85-04566 2H

HARRINGTON, L.
Review of the Food and Drug Administration Risk Analysis for Polychlorinated Biphenyls in Fish,
W85-04775 5C

HARRISON, D.
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

HARRISON, P. J.
Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

HARRISON, W. D.
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

HARTIG, J. H.
Seasonal Variation of Nutrient Limitation in Western Lake Erie,
W85-04719 2H

HARVEY, T. M.
Scheme for the Direct Analysis of Organics in the Environment by Tandem Mass Spectrometry,
W85-04656 5A

HASKIN, E.
Oyster Reefs as Processors of Estuarine Materials,
W85-04483 2L

HASWELL, S. J.
Arsenic Speciation in Soil-Pore Waters From Mineralized and Unmineralized Areas of South-West England,
W85-04662 2K

HAVLIK, B.
Migration and Speciation of Lead in a River System Heavily Polluted From a Smelter,
W85-04484 5B

HAYES, C. R.
Evaluation of Eutrophication Impact in Public Water Supply Reservoirs in East Anglia,
W85-04451 5C

HAYES, J. C.
Performance of Grass Filters Under Laboratory and Field Conditions,
W85-04729 2J

HAYES, P. S.
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

HAYEUR, G.
Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

HAYMES, G. T.
Attraction of Fish to Mercury Vapour Light and Its Application in a Generating Station Forebay,
W85-04914 8I

HE, L.
Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

HEBDEN, D.
Some Aspects of the Use of Oxidation Techniques in the Treatment of Sewage,
W85-04822 5D

HEERMANN, D. F.
Integrated Water-Energy Management System for Center Pivot Irrigation: Functional Requirements,
W85-04742 7C

In.egrated Water-Energy Management System for Center Pivot Irrigation: Implementation,
W85-04743 7C

HEGG, R. O.
Irrigation of Swine Lagoon Effluent onto Pine and Hardwood Forests,
W85-04741 5D

HELFRICH, J. A.
Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

HELWEG, O. J.
Problems with Traditional Small Reservoir Irrigation Systems in the Semi Arid Tropics,
W85-04747 4A

HENDRICKS, D. W.
Removing Giardia Cysts with Slow Sand Filtration,
W85-04831 5F

HENDRIKSON, J. G.
Gasifier Wastewater Treatment: Phase I Cooling Tower Assessment,
W85-04879 5D

HENDZEL, M. R.
Gas Chromatographic Determination of Picloram in Fish,
W85-04433 5A

HENEBRY, M. S.
Protozoan Colonization Rates and Trophic Status of Some Freshwater Wetland Lakes,
W85-04657 2H

HENNIGAR, G. W.
Water Leakage Control and Sonic Detection,
W85-04692 3D

HENRIKSEN, A.
Changes in Base Cation Concentrations Due to Freshwater Acidification,
W85-04532 5C

HENRIQUES, P. R.
Preliminary Investigation on Effects of Fluctuating Flows on Invertebrates of the Hawea River, a Large Regulated River in New Zealand,
W85-04668 2H

HENRY, J. G.
Commercial Mining Technique Offers a New Approach to Removing Heavy Metals from Sludges,
W85-04767 5D

HENRY, R.
Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

HENTRICH, R. L. JR.
Doing a Job on Data,
W85-04651 7C

HERD, J. S.
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

HERODEK, S.
Eutrophication of Lake Balaton: Measurements, Modeling and Management,
W85-04562 5C

HERRMANN, A.
Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

HERRMANN, R.
Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Fri-

sian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland), W85-04808 5B

HERZOG, A. M.
Closed Formulae for Earthquake-Induced Deformations in Dams, W85-04782 8D

HERZOG, M.
Simplest Approximate Computation of Dam-break Waves (Die Einfachste Naherungsberechnung von Dammbruchwellen), W85-04630 8B

HEYMAN, U.
Variation of Water Quality Parameters in Meso- to Hypereutrophic Lakes, W85-04536 2H

HILLBRICHT-ILKOWSKA, A.
External and Internal Loading and Retention of Phosphorus in the R. Jorka Lakes (Masurian Lakeland, Poland) vs Their Trophic Status, W85-04556 2H

HIMEBAUGH, R. R.
Doing a Job on Data, W85-04651 7C

HINCH, L. W.
Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations, W85-04470 8A

HINDS, M. W.
Waterborne Outbreak of Hepatitis A in Meade County, Kentucky, W85-04658 5C

HITES, R. A.
Environmental Impact of Two, Adjacent, Hazardous Waste Disposal Sites in the Niagara River Watershed, W85-04718 5C

HITZHUSEN, F.
Private and Social Cost - Benefit Perspectives and a Case Application on Reservoir Sedimentation Management, W85-04447 4D

HODGSON, C. W.
Masinga Dam in Kenya, W85-04471 8A

HOLDEN, T. E.
Oxidation of Cyanides in Industrial Wastewaters by Ozone, W85-04881 5D

HOLIAN, J. O.
Analysis of Precipitation Collected on a Sequential Basis, W85-04505 5B

HOLLORAN, M. F.
Sensitivity Analysis of Reservoir Oxygen Model, W85-04585 2H

HOLM, E.
Radioecological Studies of Activation Products Released from a Nuclear Power Plant into the Marine Environment, W85-04865 5B

HOLMAN, L.
1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures, W85-04928 7B

HOLMGREN, S.
Phytoplankton in a Polluted Subarctic Lake Before and After Nutrient Reduction, W85-04490 5C

HOLMGREN, S. K.
Experimental Lake Fertilization in the Kuokkel Area, Northern Sweden. Phytoplankton Biomass and Algal Composition in Natural and Fertilized Subarctic Lakes, W85-04910 2H

HOLTZ, A. C. T.
Future of Hydropower in Brazil, W85-04779 6B

HOLWAY, J. M.
Nitrate Contamination: Public Awareness, W85-04828 5F

HOM, T.
Simultaneous Exposure of English Sole (Parophrys vetulus) to Sediment-Associated Xenobiotics: Part 1 - Uptake and Disposition of 14C-Polychlorinated Biphenyls and 3H-Benzo(a)Pyrene, W85-04870 5C

HONGVE, D.
Efficiency of Liming in Acid, Humus-Influenced Lakes, W85-04533 5G

HOPPE, H.-G.
Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance, W85-04907 2L

HORDIJK, C. A.
Comparison of Bacterial Sulfate Reduction and Methanogenesis in the Anaerobic Sediments of a Stratified Lake-Ecosystem, W85-04703 2H

HORNBERGER, G. M.
Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry, W85-04792 5C

HORNUNG, H.
Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel, W85-04863 5B

PCBs, DDTs and Other Chlorinated Hydrocarbons in Marine Organisms from the Mediterranean Coast of Israel, W85-04894 5B

HOSE, J. E.
Effects of Dechlorinated Seawater on Fish Behavior, W85-04862 5D

HOSTOVSKY, T.
Comparison of Current Methods of Poliovirus Concentration from Tap Water, W85-04492 5F

HOWARD, K. W. F.
Multistage Model for the Development of Hydrochemical Zonation in Chalk Ground Waters, W85-04634 2K

HOWELLS, G. D.
Effects of Power Station Cooling Water Discharges on Aquatic Ecology, W85-04507 5C

HOYLAND, G.
Aerobic Treatment in 'Oxitron' Biological Fluidized Bed Plant at Coleshill, W85-04593 5D

HUBNER, D.
Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Frisian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland), W85-04808 5B

HUDSON, J. A.
Industrial Effluent Treatment at Sewage-Treatment Works: The Tadcaster Experience, W85-04521 5D

HUNT, D. F.
Scheme for the Direct Analysis of Organics in the Environment by Tandem Mass Spectrometry, W85-04656 5A

HUSAR, J. D.
Regional River Sulfur Runoff, W85-04481 5B

HUSAR, R. B.
Regional River Sulfur Runoff, W85-04481 5B

HUTAREW, A.
'Rennfeld' Small-Scale Hydroelectric Power Plant Near Pforzheim (Kleinwasserkraftanlage 'Rennfeld' bei Pforzheim), W85-04629 8A

HUTCHINS, M. L.
Cellular Phosphorus Concentration as a Criterion for Trophic Status in Rapidly Flushed Lakes, W85-04846 2H

HUTTUNEN, P.
Phytoplankton in 151 Eastern Finnish Lakes: Species Composition and its Relations to the Water Chemistry, W85-04543 2H

HWANG, C. T.
Underground Utilities in Barrow, Alaska, W85-04925 6A

HYATT, K. D.
Responses of Sockeye Salmon (Oncorhynchus nerka) to Fertilization of British Columbia Coastal Lakes, W85-04847 8I

ILMAVIRTA, K.
Phytoplankton in 151 Eastern Finnish Lakes: Species Composition and its Relations to the Water Chemistry, W85-04543 2H

IMBODEN, D.
Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions), W85-04559 5G

IMHOFF, K. R.
Design and Operation of the Purification Lakes in the Ruhr Valley, W85-04459 5G

INGRAM, R. G.
Near Bottom Variations of Turbidity in the St. Lawrence Estuary, W85-04677 2L

IRVINE, J. R.
Preliminary Investigation on Effects of Fluctuating Flows on Invertebrates of the Hawea River, a Large Regulated River in New Zealand, W85-04668 2H

IRWIN, R. W.
Effects of Land Drainage on Stream Flow, W85-04583 4C

ISHIKAWA, S.
Determination of Trialkyl and Triaryl Phosphates in Environmental Samples, W85-04497 5B

JACOB, U.
Qualitative and Quantitative Entomofaunistic Investigation of an Opencast Residual Lake near Leipzig (GDR),
W85-04906 2H

JACOBSEN, N.
Case Study, Potable Water Reservoir, Tuktoyaktuk, Northwest Territories,
W85-04927 6A

JACOBSON, G.
Groundwater Seepage and the Water Balance of a Closed, Freshwater, Coastal Dune Lake: Lake Windermere, Jervis Bay,
W85-04698 2F

JAFFE, R.
Environmental Impact of Two, Adjacent, Hazardous Waste Disposal Sites in the Niagara River Watershed,
W85-04718 5C

JAIN, C. K.
Estimation of Sulphate Ions in Water and Industrial Wastes Using a Solid State Membrane Electrode,
W85-04488 7B

JANSSON, M.
Experimental Lake Fertilization: Turnover of Nitrogen and Phosphorus in Stratified and Non-Statified Subarctic Lakes in Northern Sweden,
W85-04534 2H

JASA, P. J.
Tillage Influences on Erosion During Furrow Irrigation,
W85-04749 4C

JAWORSKI, A. Z.
Pedologic Properties of New Jersey Tidal Marshes,
W85-04955 2L

JICKELLS, T. D.
Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

JINDAL, V. K.
Simultaneous Determination of Zinc and Chromate in Cooling Water by Differential Pulse Polarography,
W85-04624 5A

JINKS, S. M.
Thermal Mortality Prediction Equations for Entrainable Striped Bass,
W85-04682 5C

JOH, H.
Inorganic Nutrients Occurring in the Oxygen-deficient Bottom Water of Osaka Bay,
W85-04606 2K

JOHNSON, C. W.
Rangeland Erosion Measurements for the USLE,
W85-04728 2J

JOHNSON, H. P.
Runoff and Sediment Transport Within and From Small Agricultural Watersheds,
W85-04734 2J

Simulated Effects of Fertilizer Management on Nitrate Loss with Tile Drainage Water for Continuous Corn,
W85-04739 6G

JOHNSON, M. D.
Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

JOHNSON, M. J.
Cost-Effective Management - Revenue and Technical Monitoring,
W85-04519 6B

JOHNSON, S. H. III
Physical and Economic Impacts of Sedimentation on Fishing Activities; Nam Pong Basin, Northeast Thailand,
W85-04448 5C

JOLLER, T.
Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions),
W85-04559 5G

JONASSON, P. M.
Decline of Zoobenthos Through Five Decades of Eutrophication in Lake Esrom,
W85-04541 5C

JONES, F.
Destruction of Pathogens and Parasites in Sewage Sludge by Chemical Means,
W85-04592 5E

Health and Amenity Aspects of Surface Waters,
W85-04457 5G

JONES, M. M.
Attenuation of Chemical Elements in Acidic Leachates from Coal Mineral Wastes by Soils,
W85-04600 5B

JONES, P. A.
Chlorophenols and Their Impurities in the Canadian Environment: 1983 Supplement,
W85-04941 5B

JONES, R. I.
Light Penetration and Some Related Characteristics in Small Forest Lakes in Southern Finland,
W85-04542 2H

JONES, W. L.
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

JORAJURIA, A.
Evolution of the Community at a Station Exposed to Sewage (Marseille-Cortiou) (Evolution Du Peuplement D'une Station Soumise A Des Apports D'Eaux D'Egout (Marseille-Cortiou)),
W85-04709 5C

JOUBERT, F. DU P.
Coarse Fraction of Soils: The Role it Plays in Plant Nutrition, Liming and Irrigation,
W85-04823 2G

JOWETT, I.
Sedimentation in New Zealand Hydroelectric Schemes,
W85-04445 2J

JURELL, G.
Investigation into the Failure of a Prestressed Rock Anchor,
W85-04952 8G

JURY, K. M.
Development and Use of a Theoretical Mathematical Model for the Medway Estuary,
W85-04450 2L

JUSTIC, D.
Effects of Ecological Perturbations on Diatom Dynamics in the Model of Lake Jezero,
W85-04901 2H

Model of Diatom Dynamics in the Epilimnion of Lake Jezero on the Island of Krk,
W85-04900 2H

KADLEC, J. A.
Fire and Herbivory in a Great Salt Lake Marsh,
W85-04825 2L

KAISER, K. L. E.
Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

KAKELA, P.
Low-Head Hydropower for Local Use,
W85-04620 6B

KAL, B. F. M.
Loosdrecht Lakes Restoration Project: Hydrology and Physico-Chemical Characteristics of the Lakes,
W85-04545 2H

KALDENHOFF, H.
Determination of Spreading of Nutritive Salts in Quasi-Stagnant Waters by Using Lithium (Chloride) as Tracer and Continuous Measurement of Water-Quality Parameters (Die Bestimmung von Ausbreitungsvorgangen von Nahrsalzen in quasi stehenden Gewassern unter Verwendung des Tracers Lithium (Chlorid) und die kontinuierliche Messung von Wasserguteparametern),
W85-04810 5A

KALPANA,
Alachlor Toxicity to a Freshwater Teleost Clarias batrachus,
W85-04885 5C

KAMB, B.
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

KANWAR, R. S.
Simulated Effects of Fertilizer Management on Nitrate Loss with Tile Drainage Water for Continuous Corn,
W85-04739 6G

KAPLAN, I. R.
Capillary Gas Chromatography Determination of Volatile Organic Acids in Rain and Fog Samples,
W85-04959 5A

KAPOS, V.
Water Relations of Jamaican Upper Montane Rain Forest Trees,
W85-04824 2I

KARLIN, R. J.
Causes of a Waterborne Giardiasis Outbreak,
W85-04830 5F

KARR, A. F.
Statistical Inference for Point Process Models of Rainfall,
W85-04794 2B

KARR, J. R.
Relationships Between Woody Debris and Fish Habitat in a Small Warmwater Stream,
W85-04679 2E

KARTTUNEN, J. O.
Effects of Dissolved Organic Carbon on the Adsorption Properties of Plutonium in Natural Waters,
W85-04799 5B

KATO, K.
Studies on the Carbon Flux from Phyto- to Bacterioplankton Communities in Lake Constance,
W85-04672 2H

KAUL, L. W.
Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

KAUL, S.
Sediment Composition, Mud-water Interchanges and the Role of Macrophytes in Dal Lake, Kashmir,
W85-04904 2H

KAUSHIK, N. K.
Dissipation of Permethrin in Limnocorrals,
W85-04838 5B

KAWAI, A.
Inorganic Nutrients Occurring in the Oxygen-deficient Bottom Water of Osaka Bay,
W85-04606 2K

KAWAI, S.
Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

KAWAMURA, K.
Capillary Gas Chromatography Determination of Volatile Organic Acids in Rain and Fog Samples,
W85-04959 5A

KEEL, R. T.
Preconcentration of Submicrogram Amounts of Metals from Natural Waters for X-ray Energy Spectrometric Determination Using Pyrrolidinecarbodithioic Acid,
W85-04621 5A

KEENE, W. C.
Organic Acidity in Precipitation of North America,
W85-04499 5B

KELLOGG, R. J.
Thermal Mortality Prediction Equations for Entrainable Striped Bass,
W85-04682 5C

KENNEDY, H. M.
Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

KEREKES, J. J.
Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

KEULDER, P. C.
Leaf Area as a Measure of Standing Crop of Floating Aquatic Macrophytes,
W85-04817 2H

KHALEEL, R.
Galerkin Finite-Element Program for Simulating Unsaturated Flow in Porous Media,
W85-04645 2F

KHALIL, J. B.
Distribution of Carbonates, Bicarbonates, and pH Values in Ground Water of the Nile Delta Region, Egypt,
W85-04638 2K

KHAM, M. A.
Simultaneous Determination of Zinc and Chromate in Cooling Water by Differential Pulse Polarography,
W85-04624 5A

KHAN, A. U.
Effects of a Textile Factory Effluent on Soil and Crop Plants,
W85-04945 5D

KHILAR, K. C.
Biological Denitrification in a Fluidized Bed,
W85-04660 5D

KIDSON, R. J.
Maintenance of Drinking Water Quality: The Essential Decisions,
W85-04449 5F

KIENE, R. P.
Effects of Organic Pollutants on Methanogenesis, Sulfate Reduction and Carbon Dioxide Evolution in Salt Marsh Sediments,
W85-04872 5C

KIMES, S. C.
Runoff and Sediment Transport Within and From Small Agricultural Watersheds,
W85-04734 2J

KINDSCHY, R. R.
Method for Estimating Precipitation Amounts at Remote Field Sites,
W85-04667 2B

KING, T. D.
Effects of Dechlorinated Seawater on Fish Behavior,
W85-04862 5D

KIORTSIS, V.
Effects of Four Heavy Metals on Survival and Hatching Rate of Artemia salina (L.),
W85-04674 5C

KIRKISH, M. H.
Diurnal Cycle of Stratification in Lake Titicaca: Eddy Diffusion,
W85-04567 2H

KISSA, E.
Effects of Four Heavy Metals on Survival and Hatching Rate of Artemia salina (L.),
W85-04674 5C

KITE, S. W.
Irrigation Scheduling Under Saline High Water Tables,
W85-04744 3F

KLAUSNITZER, B.
Qualitative and Quantitative Entomofaunistic Investigation of an Opencast Residual Lake near Leipzig (GDR),
W85-04906 2H

KLOSOWSKI, S.
Typhetum angustifoliae and Typhetum latifoliae as Indicators of Various Habitats,
W85-04614 2L

KLOTZ, R. L.
Influence of Light on the Alkaline Phosphatase Activity of Selenastrum capricornutum (Chlorophyceae) in Streams,
W85-04849 2H

KNIGHT, D. H.
Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

KNIPSCHILD, F. W.
Long-term Groundwater Protection with Plastic Linings (Langfristiger Grundwasserschutz mit Kunststoffdichtungsbahnen),
W85-04633 5G

KOHONEN, T.
Influence of Sampling Frequency on the Estimates of Runoff Water Quality,
W85-04930 7B

KOKORIN, A. O.
Physical Model of the Aquatic Ecosystem,
W85-04850 2H

KOLAVALLI, S.
Physical and Economic Impacts of Sedimentation on Fishing Activities; Nam Pong Basin, Northeast Thailand,
W85-04448 5C

KONDA, T.
Seasonal Variations in Four Bacterial Size Fractions from a Hypertrophic Pond in Tokyo, Japan,
W85-04912 2H

KORYAK, M.
Vascular Riffle Flora of Appalachian Streams: The Ecology and Effects of Acid Mine Drainage on Justicia americana (L.) Vahl,
W85-04884 5C

KOVACS, G.
Extension of a Streamflow Time Series by Regression (Verlangerung einer Zeitreihe des Durchflusses mit Hilfe eines Regressionsmodells),
W85-04807 2E

KOVACS, M.
Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

KRAMER, H. A.
Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

KRANZ, J. M. S.
Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

KRAUSE, G.
Method to Measure Suspended Load Transports in Estuaries,
W85-04675 2L

KROMKAMP, J. C.
Seston-Epipelon Interrelationships in the Shallow Eutrophic Loosdrecht Lakes (The Netherlands),
W85-04547 2H

KROUSHL, P. W.
Demand Reduction: Water Conservation Through Leak Detection,
W85-04691 3D

KRUMGALZ, B. S.
Mercury Pollution in Sediments, Benthic Organisms and Inshore Fishes of Haifa Bay, Israel,
W85-04863 5B

KUILE, M.
Availability to Plants of Phosphate in Sludges Precipitated from the Effluent from Sewage Treatment,
W85-04597 5E

KUMAR, K. D.
Subsampling Program for the Estimation of Fish Impingement,
W85-04604 5C

KURIHARA, Y.
Study of Domestic Sewage Waste Treatment by the Polychaetes, Neanthes japonica and Perinereis nuntia var. vallata, on an Artificial Tidal Flat,
W85-04903 5D

KUTERA, J.
Wastewater Disposal and Utilization in Agriculture in Poland and Hungary,
W85-04664 5E

KUUL', I. S.
Investigation of the Stability of River and Canal Channels,
W85-04422 2J

KUWAMOTO, T.
Ion Chromatographic Determination of Silicic Acid in Natural Water,
W85-04623 2K

KUWATA, K.
Trace Determination of Aldehydes in Water by High-Performance Liquid Chromatography,
W85-04622 5A

LA TOUCHE, M. C. D.
Cost Sharing in a Multipurpose Water Project,
W85-04778 6C

LACROIX, G. L.
Survival of Eggs and Alevins of Atlantic Salmon (Salmo salar) in Relation to the Chemistry of Interstitial Water in Redds in Some Acidic Streams of Atlantic Canada,
W85-04845 5C

LALCHANDANI, A.
Removal of New Indicators by Coagulation and Filtration,
W85-04833 5F

LAM, S.
Utilities Delivery for the Indian and Inuit Affairs Program,
W85-04916 6B

LAMOTHE, P.
Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

LANDIN, V. P.
System of Practices for Preventing Water by Agricultural Chemicals,
W85-04619 5G

LANE, P. A.
Comparison of Plankton-Water Chemistry Relationships in Three Acid Stressed Lakes in Nova Scotia, Canada,
W85-04911 2H

LARA, J. M.
Computing Degradation and Local Scour,
W85-04934 2J

LARSEN, I. L.
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

LARSON, C. L.
Controlling Erosion and Sedimentation in the Panama Canal Watershed,
W85-04442 4D

LARSON, G. E.
Possible Relationships Between Surface Water Chemistry and Aquatic Plants in the Northern Great Plains,
W85-04697 2H

LASETER, J. L.
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

LAUER, J.
Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions,
W85-04498 5F

LAWACZ, W.
External and Internal Loading and Retention of Phosphorus in the R. Jorka Lakes (Masurian Lakeland, Poland) vs Their Trophic Status,
W85-04556 2H

LAWLER, G. C.
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

LAWRENCE, J. R.
D/H Ratios of Sap in Trees: Implications for Water Sources and Tree Ring D/H Ratios,
W85-04758 2I

LAWSON, P. S.
Adsorption and Complexation Mechanisms of Heavy Metal Uptake in Activated Sludge,
W85-04411 5D

LAZIC, S.
Some Characteristics of Chemical Crystallization in Water Purification Process,
W85-04409 5F

LEACH, F. R.
Determination of Microbial Cell Numbers in Subsurface Samples,
W85-04636 5A

LEAN, D.
Dissipation of Permethrin in Limnocorrals,
W85-04838 5B

LECOINTE, O.
Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

LEDREW, E. F.
Small Format, Hand Held Helicopter Based Photography for Monitoring Industrial Water Effluent Plumes,
W85-04586 7B

LEENTVAAR, P.
Loosdrecht Lakes Restoration Project, an Introduction,
W85-04544 2H

LEGGE, F.
Malawi - Driving a 9 m Diameter Power Conduit with Low Cover at Nkula Falls,
W85-04819 8A

LEGOVIC, T.
Effects of Ecological Perturbations on Diatom Dynamics in the Model of Lake Jezero,
W85-04901 2H

Model of Diatom Dynamics in the Epilimnion of Lake Jezero on the Island of Krk,
W85-04900 2H

LEHTINEN, K.-J.
Toxicity of Effluents from a TiO2 Plant to the Harpacticoid Copepod Nitocra spinipes Boeck,
W85-04866 5C

LEITCH, J. A.
Proposed Framework for Developing a Multidisciplinary Wetlands Valuation Model,
W85-04684 2L

LEMLEY, A. T.
Nitrate Contamination: Public Awareness,
W85-04828 5F

LEONARD, R. A.
Movement of Water in a Plinthic Paleudult Using a Bromide Tracer,
W85-04957 2G

Nutrient Budgets for Agricultural Watersheds in the Southeastern Coastal Plain,
W85-04826 6G

LESTER, J. N.
Adsorption and Complexation Mechanisms of Heavy Metal Uptake in Activated Sludge,
W85-04411 5D

LEUENBERGER, C.
Influence of pH and Ionic Strength on the Aqueous-Nonaqueous Distribution of Chlorinated Phenols,
W85-04803 5B

LEVINA, S. I.
Discontinuous Wave on Stretches of an Abrupt Expansion of a Canal,
W85-04424 8B

LEVINGS, C. D.
Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

LEVY, J. Q.
Investigation into the Hydraulic Resources of a Lagoon in Portugal,
W85-04461 5G

LI, Q.
Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

LI, Y.
Exploiting Seasonal Energy from Small Hydropower Stations,
W85-04948 6B

LIGOTINO, R. J.
Thermal Mortality Prediction Equations for Entrainable Striped Bass,
W85-04682 5C

LIKENS, G. E.
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

LIM, L. H.
Tolerance to and Uptake of Lead in the Green Mussel, Perna viridis (L.),
W85-04708 5C

LIN, C. H.
Evaluation of a Moving-Co-ordinate System Model of Salinity Intrusion into the Mersey Estuary,
W85-04528 2L

Note on the Prediction of Dissolved Oxygen Concentration in Estuaries,
W85-04529 2L

LIN, S. D.
Giardia Lamblia and Water Supply,
W85-04829 5F

LINDMARK, G. K.
Acidified Lakes: Ecosystem Response Folowing Sediment Treatment with Sodium Carbonate,
W85-04539 5G

LITTLE, R. W.
Screening: A New Approach,
W85-04523 5D

LLOYD, P. J.
Pollution Management and the Tidal Thames,
W85-04527 5G

LOCK, J. D.
Use of Bacteriological Indicators for Swimming Water Quality,
W85-04765 5A

LOGSDON, G. S.
Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

Removing Giardia Cysts with Slow Sand Filtration,
W85-04831 5F

LOKKE, H.
Ecoepidemiology - A Casuistic Discipline Describing Ecological Disturbances and Damages in Relation to Their Specific Causes: Exemplified by Chlorinated Phenols and Chlorophenoxy Acids,
W85-04777 5C

LOOMIS, S. A.
Rangeland Erosion Measurements for the USLE,
W85-04728 2J

LORE, F.
Influence of the Charge Density of Cationic Polyelectrolytes on Sludge Conditioning,
W85-04494 5D

LORENZ, W. T.
New Ideas Reshaping Treatment Technologies,
W85-04751 5D

LOS, F. J.
Modelling Eutrophication in Shallow Dutch Lakes,
W85-04551 5C

LOUTIT, M. W.
Effect of Effluent High in Chromium on Marine Sediment Aerobic Heterotrophic Bacteria,
W85-04869 5C

LOWE, P.
Accelerated Cold Digestion: A New Look at an Old Technique,
W85-04591 5D

LOWERY, B.
Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

LOWRANCE, R. R.
Nutrient Budgets for Agricultural Watersheds in the Southeastern Coastal Plain,
W85-04826 6G

LOWTHION, D.
Nutrient Removal Trials and Bioassay Evaluation at Budds Farm Sewage-Treatment Works, Havant,
W85-04526 5D

LU, J.
Medium and Small Masonry Arch Dams in China,
W85-04950 8A

LUGTEN, M.
Comparison of Current Methods of Poliovirus Concentration from Tap Water,
W85-04492 5F

LYAMIN, M. YA.
Physical Model of the Aquatic Ecosystem,
W85-04850 2H

LYSENKO, P. E.
High-Head Spillway with Swirling of the Flow in the Outlet Section,
W85-04420 8A

MA, X.
Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

MAAS, H.
Aquatic Toxicity of 2,6-Dichlorobenzamide (BAM), a Degradation Product of the Herbicide Dichlobenil,
W85-04944 5C

MABBS-ZENO, C. C.
Opportunity Costs of Preserving Coastal Wetlands: A Case Study of a Recreational Housing Development,
W85-04754 6B

MACGREGOR, B.
Private and Social Cost - Benefit Perspectives and a Case Application on Reservoir Sedimentation Management,
W85-04447 4D

MACINTYRE, S.
Vertical Mixing in Amazon Floodplain Lakes,
W85-04569 2H

MAES, L.
Changes in the Oxygen Balance of a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Zuurstofbalans van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04889 5G

Changes of Organic and Inorganic Nitrogen in a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Organische en Anorganische Stikstof van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04890 5G

MAHAJAN, S. P.
Biological Denitrification in a Fluidized Bed,
W85-04660 5D

MAIOLIE, M.
Colorado Cooperative Fishery Research Unit Studies of Twin Lakes, Colorado: 1980 Report of Findings,
W85-04937 5C

MAKI, J. S.
Retrieval of Material from the Surface Microlayer with Screen and Plate Samplers and its Implications for Partitioning of Material within the Microlayer,
W85-04895 5A

MALOSZEWSKI, P.
Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

MANN, M. D.
Gasifier Wastewater Treatment: Phase I Cooling Tower Assessment,
W85-04879 5D

MARKOVA, N. E.
Fundamental Differential Equation of Flow of a Fluid with a Variable Mass in the Case of Bilateral Water Diversion,
W85-04428 2E

MARRON, D. C.
Contrast in Stream-Channel Response to Major Storms in Two Mountainous Areas of California,
W85-04836 2J

MARTEL, C. J.
Heating Enclosed Wastewater Treatment Facilities with Heat Pumps,
W85-04924 6A

MARTEN, G. G.
Radiotracer Estimation of Microbial Biomass in Lake Sediment,
W85-04848 2H

MARTIN, R. W.
Sewage Pump Station Design for Barrow, Alaska,
W85-04926 8C

MARTINES, H. P.
Kinematic Structure of Flow in a Trapezoidal Channel,
W85-04421 8B

MASON, R. J.
Apples and Oranges: Toward a Critique of Public Participation in Great Lakes Decisions,
W85-04573 6A

MATHERS, T.
Rainfall Interception on a Small Forested Watershed within the Kawartha Lakes Region,
W85-04578 2I

MATHIAS, J. A.
Gas Supersaturation as a Cause of Early Spring Mortality of Stocked Trout,
W85-04844 2H

MATSON, J. V.
Enhance Cooling-Water Reuse with Sidestream Softening,
W85-04469 5F

MATTSSON, S.
Radioecological Studies of Activation Products Released from a Nuclear Power Plant into the Marine Environment,
W85-04865 5B

MATUKHNO, YU. D.
System of Practices for Preventing Water by Agricultural Chemicals,
W85-04619 5G

MAUSER, M. W.
Operation and Maintenance Considerations for the Design of Arctic Water Systems,
W85-04923 6A

MAXIM, L. D.
Review of the Food and Drug Administration Risk Analysis for Polychlorinated Biphenyls in Fish,
W85-04775 5C

MAY, B. D.
Determination of COD by a Mercury-Free Open-Tube Method,
W85-04467 5A

MCALLISTER, C. D.
Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

MCBEAN, E.
Zero Side Yard Housing, Acceptance and Stormwater Management Implications,
W85-04580 4A

MCBEAN, E. A.
Methodology for Pollution Control Decision Analysis,
W85-04582 5G

MCBEATH, I.
Decomissioning of Mercury Cell Chlor-Alkali Plants in Canada,
W85-04939 5B

MCCARTY, P. L.
Performance Characteristics of the Anaerobic Baffled Reactor,
W85-04495 5D

MCCUBBIN, N.
Basic Technology of the Pulp and Paper Industry and Its Environmental Protection Practices,
W85-04932 5D

MCDANIEL, V.
Corn Silage Response to Subsurface Drainage on Alluvial Soil,
W85-04738 2G

Hydraulic Conductivity Measured Electronically in an Auger Hole,
W85-04740 2G

MCDOWELL, D. M.
Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

MCFARLAND, M. J.
Stomatal Responses to Leaf Water Potentials of Drip Irrigated Peach (Prunus persica),
W85-04746 2I

MCFARLANE, R. C.
Lawn and Garden Watering Regulations: Conservation Through a Water Use Index,
W85-04695 3D

MCINTOSH, P. T.
Cost Sharing in a Multipurpose Water Project,
W85-04778 6C

MCKAY, C. P.
Thickness of Ice on Perennially Frozen Lakes,
W85-04883 2C

MCNULTY, M. F.
Arizona Water Issues: Contrasting Economic and Legal Perspectives,
W85-04756 6E

MEHLHAFF, P.
Effects of Dissolved Organic Carbon on the Adsorption Properties of Plutonium in Natural Waters,
W85-04799 5B

MEHLUM, F.
Concentrations of Seabirds Along the Face of Glaciers and Outlets of Rivers in Svalbard (Konsentrasjoner av sjofugl langs kanten av isbreer og utenfor breelver pa Svalbard),
W85-04608 2L

MEIJER, H. A.
Industrial Effluent Control in the Netherlands and Legislation in this Field in Some Other European Countries,
W85-04520 5G

MELACK, J. M.
Amazon Floodplain Lakes: Shape, Fetch, and Stratification,
W85-04568 2H

Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes,
W85-04789 5C

Vertical Mixing in Amazon Floodplain Lakes,
W85-04569 2H

MELIKHOV, I. V.
Some Characteristics of Chemical Crystallization in Water Purification Process,
W85-04409 5F

MENDELSSOHN, I. A.
Effects of Soil Waterlogging on the Energy Status and Distribution of Salix nigra and S. exigua (Salicaceae) in the Atchafalaya River Basin of Louisiana,
W85-04943 2I

MERILAINEN, J.
Phytoplankton in 151 Eastern Finnish Lakes: Species Composition and its Relations to the Water Chemistry,
W85-04543 2H

MERMOUD, F.
5-alpha(H)-Cholestan-3-alpha-ol in Sediments: Characterization and Geochemical Significance,
W85-04759 2K

MIKASHVILI, YU. N.
Risk of Damage and Failure of Earth Dams,
W85-04430 8D

MIKELADZE, G. T.
Determination of Certain Rheological Characteristics of Concrete Mixes by Shear Testing,
W85-04425 8F

MILBURN, B.
Case Study, Potable Water Reservoir, Tuktoyaktuk, Northwest Territories,
W85-04927 6A

Water Conservation in the Northwest Territories - Public Education and Awareness Program,
W85-04920 3D

MILLER, R. D.
Fate of Contaminants During Treatment of H-Coal Process Wastewaters,
W85-04878 5D

MILLERD, F. W.
Role of Pricing in Managing the Demand for Water,
W85-04686 6A

MILLERO, F. J.
Effect of Ionic Interactions on the Oxidation of Metals in Natural Waters,
W85-04761 2K

MILLS, K. H.
Responses of Lake Whitefish (Coregonus clupeaformis) to Fertilization of Lake 226, the Experimental Lakes Area,
W85-04840 8I

MINSHAL, G. W.
Species Richness in Streams of Different Size from the Same Drainage Basin,
W85-04665 2H

MISHUEV, A. V.
Discontinuous Wave on Stretches of an Abrupt Expansion of a Canal,
W85-04424 8B

MITCHELL, B.
Floodplain Policy and Practice in the Credit River Watershed, Ontario,
W85-04587 6F

River Basin Planning: Problems, Opportunities and Implications for Ontario Conservation Authorities,
W85-04572 6A

MOBLEY, M. C.
Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

MOED, J. R.
Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

MOHAMMAD, F. S.
Effect of Drain Tube Openings on Drainage and Subirrigation,
W85-04748 4A

MOLLER, H.
Trace Metal and PCB Content of Mussels (Mytilus edulis) from the Southwestern Baltic Sea,
W85-04902 5B

MONTGOMERY, H. A. C.
Effects of the Recharge on Sewage Effluents Upon the Quality of Chalk Groundwater,
W85-04462 5C

MOODY, C. D.
Water Quality of the Colorado River System: Historical Trends in Concentration Load, and Mass Fraction of Inorganic Solutes,
W85-04942 2E

MOOG, O.
Stream Phosphorus Exports from Prealpine Watersheds with Respect to Geology and Land Use,
W85-04560 5B

MOORE, C. G.
BASIC Program for the Investigation of Species Diversity,
W85-04513 7C

MOORE, I. D.
Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

MORAITOU-APOSTOLOPOULOU, M.
Effects of Four Heavy Metals on Survival and Hatching Rate of Artemia salina (L.),
W85-04674 5C

MORAWSKA, B.
Effect of Water Temperature Elevation on Incipient and Cumulative Fecundity of Batch-Spawning Tench, Tinca tinca (L.),
W85-04707 8I

MORGAN, D.
Maintenance of Drinking Water Quality: The Essential Decisions,
W85-04449 5F

MORSE, R.
Management of Sediment in New South Wales, Australia,
W85-04444 4D

MORTLOCK, R. A.
Geochemistry of Inorganic Germanium In Natural Waters,
W85-04482 2K

MOSS, J.
Sewage Sludge Treatment and Disposal - The Way Ahead,
W85-04455 5E

MOZELL, E.
Oxygen Injection Cuts Odors,
W85-04652 5D

MROZ, W. J.
Effect of Anthropogenous Changes of Water Conditions on the Vegetation in the Forest Reserve Las Bielanski in Warsaw (Wplyw antropogennych zmian stosunkow wodnych na roslinnosc rezerwatu Las Bielanski w Warszawie),
W85-04610 4C

MUELLER, D. K.
Water Quality of the Colorado River System: Historical Trends in Concentration Load, and Mass Fraction of Inorganic Solutes,
W85-04942 2E

MUIR, D. C. G.
Gas Chromatographic Determination of Picloram in Fish,
W85-04433 5A

MUIR, T. C.
Integrated Planning System for Hydro Development in Ecuador,
W85-04780 6A

MULAMOOTTIL, G.
Zero Side Yard Housing, Acceptance and Stormwater Management Implications,
W85-04580 4A

MUNN, R. E.
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

MUNSTER, U.
Distribution, Dynamic and Structure of Free Dissolved Carbohydrates in the Plussee, a North German Eutrophic Lake,
W85-04552 2H

MUR, L. R.
Loosdrecht Lakes Restoration Project, an Introduction,
W85-04544 2H

MURAV'EV, O. A.
Mathematical Modeling of Hydraulic Regimes in the Transition Between the Surge Tank and Conduits of a Hydroelectric Station,
W85-04419 8B

Optimization of Design Parameters of Complex Surge Tanks,
W85-04426 8A

MUSTY, P.
Optimization of Coleshill Activated-Sludge Plant Operating Conditions,
W85-04590 5D

NAGUIB, M.
Methanogenesis in Sediments of Eutrophic Lakes; 2. Comparative Investigations on the Methane-Precursor Preference,
W85-04554 2H

NAKAMOTO, M.
Trace Determination of Aldehydes in Water by High-Performance Liquid Chromatography,
W85-04622 5A

NARJARI, N. K.
Biological Denitrification in a Fluidized Bed,
W85-04660 5D

NASSEHZADEH-TABRIZI, A.
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

NAZAROV, A. V.
Experience in Operating the Bratsk Reservoir,
W85-04429 4A

NCINERNEY, J.
1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures,
W85-04928 7B

NEALE, P. J.
Diurnal Cycle of Stratification in Lake Titicaca: Eddy Diffusion,
W85-04567 2H

NEILL, C.
Natural Factors and Human Modifications Contributing to Marsh Loss in Louisiana's Mississippi River Deltaic Plain,
W85-04603 2L

NELSON, D. M.
Effects of Dissolved Organic Carbon on the Adsorption Properties of Plutonium in Natural Waters,
W85-04799 5B

NELSON, M.
Economic/Institutional Issues in Sedimentation Management in Developing Countries,
W85-04443 4D

NELSON, W. C.
Proposed Framework for Developing a Multidisciplinary Wetlands Valuation Model,
W85-04684 2L

NIELSEN, T. S.
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

NIGHTINGALE, H. I.
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

NILSSON, M.
Radioecological Studies of Activation Products Released from a Nuclear Power Plant into the Marine Environment,
W85-04865 5B

NIMZ, C. F.
Species Richness in Streams of Different Size from the Same Drainage Basin,
W85-04665 2H

NISBET, I. C. T.
Organochlorine Residues in Common Terns and Associated Estuarine Organisms, Massachusetts, USA, 1971-81,
W85-04861 5B

NIX, S. J.
Residence Time in Stormwater Detention Basins,
W85-04968 5D

NOCETI, R. P.
Fate of Contaminants During Treatment of H-Coal Process Wastewaters,
W85-04878 5D

NOLAN, K. M.
Contrast in Stream-Channel Response to Major Storms in Two Mountainous Areas of California,
W85-04836 2J

NOYE, J.
Physical Processes and Pollution in the Waters of Spencer Gulf,
W85-04763 2L

NUNN, G.
Cost-Effective Management - Revenue and Technical Monitoring,
W85-04519 6B

NYARY, I.
Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

O'NEILL, P.
Arsenic Speciation in Soil-Pore Waters From Mineralized and Unmineralized Areas of South-West England,
W85-04662 2K

OCHS, C. A.
Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes,
W85-04789 5C

OCHS, H. J.
Filter Foam - Perfect in Many Fields (Filterschaum - Perfekt in Vielen Bereichen),
W85-04632 5F

ODA, K.
Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

ODELL, B.
Solving the Problem of Rehabilitating Decayed Sewer Systems,
W85-04768 8A

OGATA, M.
Organic Sulfur Compounds and Polycyclic Hydrocarbons Transferred to Oyster and Mussel from Petroleum Suspension; Identification by Gas Chromatography and Capillary Mass Chromatography,
W85-04496 5C

OHLE, W.
Measurement and Comparative Values of the Short Circuit Metabolism (SCM) of Lakes by POC Relationship of Primary Production of Phytoplankton and Settling Matter,
W85-04701 2H

OHM, K.
Method to Measure Suspended Load Transports in Estuaries,
W85-04675 2L

OKADA, T.
Ion Chromatographic Determination of Silicic Acid in Natural Water,
W85-04623 2K

OLIVER, J.
Recent Developments in Leak Noise Correlation Techniques,
W85-04958 8G

OLLA, B. L.
Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

OLSEN, C. R.
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

OLSHINA, A.
Brackish Groundwater as an Alternative Source of Cooling Water for Nuclear Power Plants in Israel,
W85-04599 4B

ONISTO, L. J.
Attraction of Fish to Mercury Vapour Light and Its Application in a Generating Station Forebay,
W85-04914 8I

ORD, W. O.
Pollution Control Policies for the Tees Estuary,
W85-04525 5G

OSBORNE, J. A.
Phytoplankton Responses to Reduction and Elimination of Submerged Vegetation by Herbicides and Grass Carp in Four Florida Lakes,
W85-04857 5G

OSSENBRUGGEN, P. J.
Time Series Models for Treatment of Surface Waters,
W85-04965 5F

OTSUKI, A.
Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer,
W85-04673 2L

OUCHI, A.
Prediction of Red Tide Occurrence by Means of Discriminant Analysis (in Japanese),
W85-04605 5C

OUTHET, D.
Management of Sediment in New South Wales, Australia,
W85-04444 4D

OUTTRAM, D. P.
Different Approach to Water Quality Sampling,
W85-04524 5A

PAINTER, H. A.
Biodegradability of Two Primary Alcohol Ethoxylate Nonionic Surfactants Under Practical Conditions, and the Toxicity of the Biodegradation Products to Rainbow Trout,
W85-04487 5D

PALMER, M. D.
Use of Bacteriological Indicators for Swimming Water Quality,
W85-04765 5A

PARISH, R. C.
Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

PARKER, J. C.
Comparison of Field- and Laboratory-Measured and Predicted Hydraulic Properties of a Soil with Macropores,
W85-04617 2G

PARMA, S.
Looadrecht Lakes Restoration Project, an Introduction,
W85-04544 2H

PARSONS, J. E.
Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

PARSONS, T. R.
Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

PARTHASARATHY, N.
Importance of Speciation Methods in Analytical Control of Water Treatment Processes With Application to Fluoride Removal From Waste Waters,
W85-04485 5A

PASTERNAK, P. S.
System of Practices for Preventing Water by Agricultural Chemicals,
W85-04619 5G

PATEL, B.
Heavy Metals in the Bombay Harbour Area,
W85-04892 5C

PATEL, S.
Heavy Metals in the Bombay Harbour Area,
W85-04892 5C

PATRIC, W.
Low-Head Hydropower for Local Use,
W85-04620 6B

PATRICK, P. H.
Attraction of Fish to Mercury Vapour Light and Its Application in a Generating Station Forebay,
W85-04914 8I

PATRY, G. G.
Linear Programming Model for the Control of Combined Sewer Systems with Off-Line Storage Facilities,
W85-04576 5G

PATTON, P. C.
Sediment Storage and Terrace Formation in Coyote Gulch Basin, South-Central Utah,
W85-04646 2J

PAWLEY, J. D.
Managing Summer Lawn Irrigation Demands: A Water Use Index,
W85-04694 3D

PEARSON, W. H.
Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

PEDROS-ALIO, C.
Zooplankton Dynamics in Lake Mendota: Short-term Versus Long-term Changes,
W85-04897 2H

PEMBERTON, E. L.
Computing Degradation and Local Scour,
W85-04934 2J

PENCZAK, T.
Phosphorus, Nitrogen, and Carbon Cycling by Fish Populations in Two Small Lowland Rivers in Poland,
W85-04888 5B

PENROSE, W. R.
Effects of Dissolved Organic Carbon on the Adsorption Properties of Plutonium in Natural Waters,
W85-04799 5B

PERKINS, H. F.
Movement of Water in a Plinthic Paleudult Using a Bromide Tracer,
W85-04957 2G

PETERSEN, R. C. JR.
Species Richness in Streams of Different Size from the Same Drainage Basin,
W85-04665 2H

PFEIFFER, W. C.
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

PHETTEPLACE, G.
Heating Enclosed Wastewater Treatment Facilities with Heat Pumps,
W85-04924 6A

PHILLIPS, G. L.
Large-Scale Field Experiment in the Control of Eutrophication in the Norfolk Broads,
W85-04465 5G

PIERCE, R. S.
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

PIESOLD, D. D. A.
Masinga Dam in Kenya,
W85-04471 8A

PINDER, G. F.
Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; I. Equation Development,
W85-04787 5B

Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; 2. Numerical Simulation,
W85-04788 5B

PIONKE, H. B.
Effect of Agricultural Land Use on Ground-Water Quality in a Small Pennsylvania Watershed,
W85-04642 5B

PLAA, G. L.
Subchronic Effects of a Mixture of 'Persistent' Chemicals Found in the Great Lakes,
W85-04479 5C

POLLARD, D.
Embryo Abnormalities in the Periwinkle, Littorina 'saxatilis', as Indicators of Stress in Polluted Marine Environments,
W85-04893 5A

POLLEN, M. R.
Water Conservation in Barrow, Alaska,
W85-04918 6B

POLPRASERT, C.
Dispersion Model for Waste Stabilization Ponds,
W85-04966 5D

POTRATZ, C. J.
Estimating the Parameters of a Cube Root Normal Distribution from Reduced Sample Data,
W85-04796 2B

POWELL, N. L.
Comparison of Field- and Laboratory-Measured and Predicted Hydraulic Properties of a Soil with Macropores,
W85-04617 2G

POWELL, T.
Diurnal Cycle of Stratification in Lake Titicaca: Eddy Diffusion,
W85-04567 2H

PREMAZZI, G.
Availability of Sediment P in Lake Lugano,
W85-04563 2H

Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

PREPAS, E. E.
Modelling Winter Oxygen Depletion Rates in Ice-Covered Temperate Zone Lakes in Canada,
W85-04843 2H

PRIKHOD'KO, N. N.
System of Practices for Preventing Water by Agricultural Chemicals,
W85-04619 5G

PROVINI, A.
Internal P Loading in Lakes: A Different Approach to its Evaluation,
W85-04723 2H

PUNTHAKEY, J. F.
Stomatal Responses to Leaf Water Potentials of Drip Irrigated Peach (Prunus persica),
W85-04746 2I

RABKOVA, E. K.
Kinematic Structure of Flow in a Trapezoidal Channel,
W85-04421 8B

RACK, C.
Theory of Fuzzy Subsets and Its Applications to Water-Resources Planning (Die Theorie unscharfer Teilmengen und ihre Anwendung in der Wasserwirtschaft),
W85-04806 6A

RAICH, J. W.
Throughfall and Stem Flow in Mature and Year-Old Wet Tropical Forest,
W85-04853 2I

RAPIN, F.
Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides,
W85-04757 5B

RAU, R.
Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

RAVERA, O.
Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

RAVID, R.
PCBs, DDTs and Other Chlorinated Hydrocarbons in Marine Organisms from the Mediterranean Coast of Israel,
W85-04894 5B

RAYMOND, C. F.
Glacier Surge Mechanism: 1982-1983 Surge of Variegated Glacier, Alaska,
W85-04472 2C

RAYNER, F. A.
LGWRES - Life of Ground-Water Reserves,
W85-04643 4B

REASONER, D. J.
Bacterial Colonization of Point-of-Use Water Treatment Devices,
W85-04834 5F

RECZYNSKA-DUTKA, M.
Snow Pollution and Its Effect on Heavy Metals Load of the Kozlowa Gora Reservoir as Compared to Rain and River Water,
W85-04611 5B

REES, R. L. G.
Nutrient Removal Trials and Bioassay Evaluation at Budds Farm Sewage-Treatment Works, Havant,
W85-04526 5D

REGAMEY, J. M.
Reservoir Storage Equation Experimentally Verified,
W85-04416 2E

REGENS, J. L.
Acid Deposition Control, A Benefit-Cost Analysis: Its Prospects and Limits,
W85-04798 6B

REICHMAN, G. A.
Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
W85-04727 2D

REID, D. F.
Radium Variability Produced by Shelf-water Transport and Mixing in the Western Gulf of Mexico,
W85-04712 2K

REILLY, R. J.
Vascular Riffle Flora of Appalachian Streams: The Ecology and Effects of Acid Mine Drainage on Justicia americana (L.) Vahl,
W85-04884 5C

REINS, A.
Macrophytes in the Loosdrecht Lakes: A Story of Their Decline in the Course of Eutrophication,
W85-04549 5C

REMSEN, C. C.
Retrieval of Material from the Surface Microlayer with Screen and Plate Samplers and its Implications for Partitioning of Material within the Microlayer,
W85-04895 5A

REYNOLDS, D. M.
Trees Scars to Determine the Frequency and Stage of High Magnitude River Ice Drives and Jams, Red Deer, Alberta,
W85-04589 7B

REYNOLDS, L. M.
Organochlorine Residues in Common Terns and Associated Estuarine Organisms, Massachusetts, USA, 1971-81,
W85-04861 5B

RIBAUDO, M. O.
Importance of Sample Discriminstion in Using the Travel Cost Method to Estimate the Benefits of Improved Water Quality,
W85-04753 6B

RICHARD, D. I.
Phytoplankton Responses to Reduction and Elimination of Submerged Vegetation by Herbicides and Grass Carp in Four Florida Lakes,
W85-04857 5G

RICHARDOT-COULET, M.
Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

RICHERSON, P. J.
Diurnal Cycle of Stratification in Lake Titicaca: Eddy Diffusion,
W85-04567 2H

Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

RICHOUX, P.
Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

RIEGER, A. W.
Gas Chromatographic Determination of Picloram in Fish,
W85-04433 5A

ROBERTSON, W. A.
Sewage Pump Station Design for Barrow, Alaska,
W85-04926 8C

ROBINSON, J.
Treatment of Sewage for Use in Municipal Irrigation in Abu Dhabi, UAE,
W85-04464 5D

ROBINSON, M. S.
Pilot-Plant Evaluation of a Deep Shaft Linked to Conventional Aeration Without Inter-Stage Settlement to Give a Fully-Nitrified Effluent,
W85-04452 5D

ROBINSON, P. J.
Aerobic Treatment in 'Oxitron' Biological Fluidized Bed Plant at Coleshill,
W85-04593 5D

ROMEIJN, K.
Ecology of Meiofauna in an Organically Polluted Estuarine Mudflat,
W85-04676 2L

ROSENOW, W.
Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

ROTT, E.
Phytoplankton as Biological Parameter for the Trophic Characterization of Lakes,
W85-04561 2H

ROUX, C.
Macroinvertebrates as 'Describers' of Morphological and Hydrological Types of Aquatic Ecosystems Abandoned by the Rhone River,
W85-04722 2H

ROWE, P. W.
Jamuna River 230 kV Crossing - Bangladesh, I. Design of Foundations,
W85-04470 8A

ROWLAND, R. G.
PCB Resistance within Phytoplankton Populations in Polluted and Unpolluted Marine Environments,
W85-04864 5C

ROY, D.
Removal of New Indicators by Coagulation and Filtration,
W85-04833 5F

RUMSEY, P. B.
Prediction and Control of Ground Movement Associated with Trench Excavation,
W85-04516 8D

RUNNING, S. W.
Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

RUSE, L. P.
Monitoring of River Water Quality within the Great Ouse Basin Using the Chironomid Exuvial Analysis Technique,
W85-04454 5A

RUSSEK, E.
Quantification of Stream Drift,
W85-04842 2H

RUTHERFORD, J. C.
Trends in Lake Rotorua Water Quality,
W85-04669 2H

RYAN, W. L.
Status of Sanitation Facilities in Alaska - 1982,
W85-04915 6B

SAAD, M. A. H.
Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 1. Environmental Conditions,
W85-04710 5C

Effect of Pollution on the Coastal Waters of the Red Sea in Front of Jeddah, Saudi Arabia; 2. Nutrient Salts,
W85-04711 5C

SAAVEDRA, J.
Integrated Planning System for Hydro Development in Ecuador,
W85-04780 6A

SALO, J. E.
Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

SANDHYA,
Alachlor Toxicity to a Freshwater Teleost Clarias batrachus,
W85-04885 5C

SASSER, C. E.
Vegetation and Primary Production in a Floating Freshwater Marsh in Louisiana,
W85-04855 2L

SASTRY, K. V.
In Vivo Effects of Cadmium on Some Enzyme Activities in Tissues of the Freshwater Catfish, Heteropneustes fossilis,
W85-04434 5C

SATOH, T.
Impact of Nutrient Load on Total Biomass and Species Succession in Lake Suwa, Japan,
W85-04565 5C

SAVABI, M. R.
Rangeland Erosion Measurements for the USLE,
W85-04728 2J

SCHILLING, W.
Measurements and Estimation in Hydrology - Ideas and Proposals for the Quantification of Errors and Uncertainties (Messungen und Schatzungen in der Hydrologie - Gedanken und Vorschlage zur Quantifizierung der Fehler und Unsicherheiten),
W85-04805 7B

SCHMELZLE, P. M.
Pressure Rises Due to Unsteady Flow, Especially in High-Lift Navigation Locks (Druckerhohungen aufgrund instationarer Stromungsvorgange, insbesondere in Schiffsschleusen mit grossen Stufenhohen),
W85-04631 8B

SCHMITT, T. G.
Comparison of Dynamic Flow Routing Methods for Urban Drainage Systems (Vergleich hydrodynamischer Berechnungsansatze zur Abfluebermittlung in Kanalnetzen),
W85-04627 8B

SCHNEIDER, R.
Trace Metal and PCB Content of Mussels (Mytilus edulis) from the Southwestern Baltic Sea, W85-04902 5B

SCHNIER, C.
Trace Metal and PCB Content of Mussels (Mytilus edulis) from the Southwestern Baltic Sea, W85-04902 5B

SCHOEMAN, F. R.
Diatoms of the Jukskei-Crocodile River System (Transvaal, Republic of South Africa): A Preliminary Check-List, W85-04814 2H

SCHRODER, W.
Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions, W85-04498 5F

SCHUETT, A. W.
Groundwater Seepage and the Water Balance of a Closed, Freshwater, Coastal Dune Lake: Lake Windermere, Jervis Bay, W85-04698 2F

SCHWARZENBACH, R. P.
Influence of pH and Ionic Strength on the Aqueous-Nonaqueous Distribution of Chlorinated Phenols, W85-04803 5B

SCOTT, H. D.
Relationships among Oxygen Flux, Soil Water Tension, and Aeration Porosity in a Drying Soil Profile, W85-04956 2G

SCOTT, W. S.
Factors Influencing the Behaviour of De-Icing Salts in an Urban Flood Control Reservoir, W85-04584 5B

SCUDLARK, J. R.
Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda, W85-04504 5B

SEILS, C.
Preconcentration of Submicrogram Amounts of Metals from Natural Waters for X-ray Energy Spectrometric Determination Using Pyrrolidinecarbodithioic Acid, W85-04621 5A

SEIP, K. L.
Impact of Nutrient Load on Total Biomass and Species Succession in Lake Suwa, Japan, W85-04565 5C

SEKI, H.
Microbial Contribution to the Mesotrophic Ecosystem of the Campbell River Estuary During Summer, W85-04673 2L

SELEDKIN, A. A.
Discontinuous Wave on Stretches of an Abrupt Expansion of a Canal, W85-04424 8B

SEPERS, A. B. J.
Influence of Varying Environmental Conditions on the Activity of Heterotrophic Bacteria, W85-04700 2H

SEVERIN, B. F.
Removal of New Indicators by Coagulation and Filtration, W85-04833 5F

SHABANOWITZ, J.
Scheme for the Direct Analysis of Organics in the Environment by Tandem Mass Spectrometry, W85-04656 5A

SHANE, S. H.
Manatee Use of Power Plant Effluents in Brevard County, Florida, W85-04696 5C

SHANNON, L. J.
Assessment of Historical Change in Two Northern Minnesota Lakes, W85-04602 5B

SHAPIRO, J.
Blue-green Dominance in Lakes: The Role and Management Significance of pH and CO2, W85-04909 2H

SHARMA, P. N.
Problems with Traditional Small Reservoir Irrigation Systems in the Semi Arid Tropics, W85-04747 4A

SHEARIN, A. T.
Irrigation of Swine Lagoon Effluent onto Pine and Hardwood Forests, W85-04741 5D

SHELEF, G.
Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions, W85-04498 5F

SHEN, W.
Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese), W85-04835 2K

SHERR, E. B.
delta 13C Measurements as Indicators of Carbon Flow in Marine and Freshwater Ecosystems, W85-04431 2K

SHINOHARA, R.
Determination of Trialkyl and Triaryl Phosphates in Environmental Samples, W85-04497 5B

SICK, L. V.
Simultaneous Accumulations of Naphthalene, a PCB Mixture, and Benzo(a)pyrene, by the Oyster, Crassostrea virginica, W85-04477 5B

SIGG, L.
Voltammetric Methods for Distinguishing between Dissolved and Particulate Metal Ion Concentrations in the Presence of Hydrous Oxides. A Case Study on Lead (II), W85-04800 5A

SILVERMAN, G. P.
Removing Giardia Cysts with Slow Sand Filtration, W85-04831 5F

SIMCO, B. A.
Confinement and Water Quality-Induced Stress in Largemouth Bass, W85-04680 5C

SIMS, A. F. E.
Tip Leachate Treatment Using Hydrogen Peroxide, W85-04522 5D

SIMS, M. J.
Acceptance of Treated Water by Northern Community Residents, W85-04921 6D

SINCERO, A. P.
Eutrophication Control and the Fallacy of Nitrogen Removal, W85-04774 5G

SINHA, B.
Role of Watershed Management in Water Resources Development Planning - Need for Integrated Approach to Development of Catchment and Command of Irrigation Projects, W85-04441 6B

SINNIGER, R.
Reservoir Storage Equation Experimentally Verified, W85-04416 2E

SINTON, L. W.
Macroinvertebrates in a Sewage-Polluted Aquifer, W85-04720 5C

SIUDA, W.
Phosphatases and Their Role in Organic Phosphorus Transformation in Natural Waters. A Review, W85-04613 2K

SKAGGS, J. W.
Waterborne Outbreak of Hepatitis A in Meade County, Kentucky, W85-04658 5C

SKAGGS, R. W.
Effect of Drain Tube Openings on Drainage and Subirrigation, W85-04748 4A

Stream Water Levels Affect Field Water Tables and Corn Yields, W85-04726 2F

SKILLINGS, J. H.
Acute Toxicity of Copper to Three Life Stages of Chrionomus tentans as Affected by Water Hardness-Alkalinity, W85-04946 5C

SLETTEN, K. K.
Possible Relationships Between Surface Water Chemistry and Aquatic Plants in the Northern Great Plains, W85-04697 2H

SLY, P. G.
Sedimentology and Geochemistry of Modern Sediments in the Kingston Basin of Lake Ontario, W85-04714 2H

SMALL, J. W. JR.
Phytoplankton Responses to Reduction and Elimination of Submerged Vegetation by Herbicides and Grass Carp in Four Florida Lakes, W85-04857 5G

SMITH, B.
Case Study, Potable Water Reservoir, Tuktoyaktuk, Northwest Territories, W85-04927 6A

SMITH, D. G.
Trees Scars to Determine the Frequency and Stage of High Magnitude River Ice Drives and Jams, Red Deer, Alberta, W85-04589 7B

SMITH, D. W.
Study of Water Bleeder Control Alternatives, W85-04922 3D

Water Conservation in Barrow, Alaska, W85-04918 6B

SMITH, J. A.
Statistical Inference for Point Process Models of Rainfall, W85-04794 2B

SMITH, L. J.
Treatment of Sewage for Use in Municipal Irrigation in Abu Dhabi, UAE, W85-04464 5D

SMITH, L. M.
Fire and Herbivory in a Great Salt Lake Marsh, W85-04825 2L

SMITS, J. G. C.
Modelling Eutrophication in Shallow Dutch Lakes,
W85-04551 5C

SNODGRASS, W. J.
Lake Ontario Oxygen Model. 1. Model Development and Application,
W85-04801 2H

Lake Ontario Oxygen Model. 2. Errors Associated with Estimating Transport Across the Thermocline,
W85-04802 2H

Sensitivity Analysis of Reservoir Oxygen Model,
W85-04585 2H

SODERGREN, A.
Small-scale Temporal Changes in the Biological and Chemical Composition of Surface Microlayers in a Eutrophic Lake,
W85-04538 2H

SOEDER, C. J.
Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions,
W85-04498 5F

SOLLINS, P.
Composition and Possible Origin of Detrital Material in Streams,
W85-04827 2J

SOLOMON, K. R.
Dissipation of Permethrin in Limnocorrals,
W85-04838 5B

SOLVIK, O.
Underwater Piercing of a Tunnel,
W85-04415 8A

SONDERGAARD, M.
Dissolved Organic Carbon in Danish Lakes: Concentration, Composition, and Lability,
W85-04540 5C

SONNANTE, G.
Influence of the Charge Density of Cationic Polyelectrolytes on Sludge Conditioning,
W85-04494 5D

SOPHOCLEOUS, M.
Role of Specific Yield in Ground-Water Recharge Estimations: A Numerical Study,
W85-04640 2F

SOSNOWSKA, J.
Some Remarks on the Ecology of Algae in Heated Waters (Uwagi o ekologii glonow w wodach podgrzanych),
W85-04609 5C

SOULSBY, P. G.
Nutrient Removal Trials and Bioassay Evaluation at Budds Farm Sewage-Treatment Works, Havant,
W85-04526 5D

SOUTHGATE, D.
Private and Social Cost - Benefit Perspectives and a Case Application on Reservoir Sedimentation Management,
W85-04447 4D

SPALDING, R. F.
Ground-Water Contamination and Well Construction in Southeast Nebraska,
W85-04637 5B

SPEAR, K. F.
Enhance Cooling-Water Reuse with Sidestream Softening,
W85-04469 5F

SPIES, R.
Benthic-Pelagic Coupling in Sewage-Affected Marine Ecosystems,
W85-04874 5C

SPOSITO, G.
Infiltration in Swelling Soils,
W85-04790 2G

SQUYRES, S. W.
Thickness of Ice on Perennially Frozen Lakes,
W85-04883 2C

SRIVASTAVA, S. K.
Estimation of Sulphate Ions in Water and Industrial Wastes Using a Solid State Membrane Electrode,
W85-04488 7B

ST, H.
Relining: The Feasibility of Inserting Pipe into Existing Sewers,
W85-04693 8A

STABEL, H.-H.
Impact of Sedimentation on the Phosphorus Content of the Euphotic Zone of Lake Constance,
W85-04555 2H

Studies on the Carbon Flux from Phyto- to Bacterioplankton Communities in Lake Constance,
W85-04672 2H

STADELMANN, P.
Effects of Internal Measures in Baldeggersee: Forced-Circulation and Oxygenation of the Hypolimnion (Die Auswirkungen von internen Massnahmen im Baldeggersee: Zwangszirrkulation und Sauerstoffbegasung des Hypolimnions),
W85-04559 5G

STANCZKOWSKA, A.
Role of Bivalves in the Phosphorus and Nitrogen Budget in Lakes,
W85-04558 2H

STAPLES, K. D.
Industrial Effluent Treatment at Sewage-Treatment Works: The Tadcaster Experience,
W85-04521 5D

STARKEL, W. M.
Predicting the Effect of Macrobenthos on the Sediment/Water Flux of Metals and Phosphorus,
W85-04839 2K

STASSEN, P. J.
Sensitivity of Stone Fruit Rootstocks to Waterlogging,
W85-04812 2I

STEAD, R. G.
Pollution Control Policies for the Tees Estuary,
W85-04525 5G

STEDINGER, J. R.
Algorithms for Optimizing Hydropower System Operation,
W85-04786 4A

STEEL, J. E. C.
Biological Considerations in the Setting of Quality Standards for the Tidal Thames,
W85-04509 5G

STEENBERGEN, C. L. M.
Carbon Mineralization in Microaerobic and Anaerobic Strata of Lake Vechten (The Netherlands): Diffusion Flux Calculations and Sedimentation Measurements,
W85-04702 2H

STEIN, J. E.
Simultaneous Exposure of English Sole (Parophrys vetulus) to Sediment-Associated Xenobiotics: Part 1 - Uptake and Disposition of 14C-Polychlorinated Biphenyls and 3H-Benzo(a)Pyrene,
W85-04870 5C

STEINHORST, R. K.
Estimating the Parameters of a Cube Root Normal Distribution from Reduced Sample Data,
W85-04796 2B

STELLA, M.
Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

STEPHENS, D. B.
Field Method to Determine Unsaturated Hydraulic Conductivity Using Flow Nets,
W85-04791 2G

STEPHENS, J. S. JR.
Effects of Dechlorinated Seawater on Fish Behavior,
W85-04862 5D

STERRITT, R. M.
Adsorption and Complexation Mechanisms of Heavy Metal Uptake in Activated Sludge,
W85-04411 5D

STEVERS, P. H.
Flow Balancing System for Stormwater and Combined Sewer Overflow,
W85-04772 5D

STICHLER, W.
Application of Tracer Techniques for Determining the Water Balance in Small Catchment Basins; A Research Concept for the Experimental Basins in the Upper Harz Mountains (Anwendung von Tracertechniken zur Erfassung des Wasserumsatzes in kleinen Einzugsgebieten; Ein Forschungskonzept fur die Oberharzer Untersuchungsgebiete),
W85-04804 2A

STOCKER, W.
Economizing the Diameter of Tunnels,
W85-04413 8A

STOCKNER, J. G.
Responses of Sockeye Salmon (Oncorhynchus nerka) to Fertilization of British Columbia Coastal Lakes,
W85-04847 8I

STODDARD, J. L.
Major Ion Chemistry and Sensitivity to Acid Precipitation of Sierra Nevada Lakes,
W85-04789 5C

STOECKER, J. G.
Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

STOEWSAND, G. S.
Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

STONES, T.
Decreasing Rate of Biochemical Oxidation of Sewage,
W85-04468 5D

STOTZKY, G.
Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies,
W85-04435 5C

STUDHOLME, A. L.
Sublethal Effects of Oiled Sediment on the Sand Worm, Nereis (Neanthes) virens: Induced Changes in Burrowing and Emergence,
W85-04871 5C

STUMM, W.
Voltammetric Methods for Distinguishing between Dissolved and Particulate Metal Ion Con-

centrations in the Presence of Hydrous Oxides. A Case Study on Lead (II),
W85-04800 5A

SUBHADRA, KM.
In Vivo Effects of Cadmium on Some Enzyme Activities in Tissues of the Freshwater Catfish, Heteropneustes fossilis,
W85-04434 5C

SUGIMAE, A.
Trace Determination of Aldehydes in Water by High-Performance Liquid Chromatography,
W85-04622 5A

SUIDAN, M. T.
Unified Analysis of Thickening,
W85-04964 5E

SUKENIK, A.
Coprecipitation of Microalgal Biomass with Calcium and Phosphate Ions,
W85-04498 5F

SULLIVAN, V. I.
Effects of Soil Waterlogging on the Energy Status and Distribution of Salix nigra and S. exigua (Salicaceae) in the Atchafalaya River Basin of Louisiana,
W85-04943 2I

SUTADIPRADJA, E.
Watershed Rehabilitation Program Related to the Management of River and Reservoir Sedimentation in Indonesia,
W85-04438 4D

SUTTON, P. A.
Migration and Attenuation of Selected Organics in a Sandy Aquifer - A Natural Gradient Experiment,
W85-04635 5B

SWIFT, C. T.
Airborne Microwave Measurements of the Southern Greenland Ice Sheet,
W85-04962 2C

SYMES, G. L.
Screening: A New Approach,
W85-04523 5D

TAKACS, J. F.
Analysis of Precipitation Collected on a Sequential Basis,
W85-04505 5B

TAKAMI, K.
Trace Determination of Aldehydes in Water by High-Performance Liquid Chromatography,
W85-04622 5A

TAKETOMI, M.
Determination of Trialkyl and Triaryl Phosphates in Environmental Samples,
W85-04497 5B

TAN, W. H.
Tolerance to and Uptake of Lead in the Green Mussel, Perna viridis (L.),
W85-04708 5C

TANNER, E. V. J.
Water Relations of Jamaican Upper Montane Rain Forest Trees,
W85-04824 2I

TAPP, J. S.
Chemical Flocculation for Suspended Solids Removal at Remote Mine Sites,
W85-04730 5D

TATE, D. M.
Canadian Water Management: A One Armed Giant,
W85-04685 6A

TATTERSFIELD, J.
Masinga Dam in Kenya,
W85-04471 8A

TAVOLARO, J. F.
Sediment Budget Study of Clamshell Dredging and Ocean Disposal Activities in the New York Bight,
W85-04598 6G

TAYLOR, C. H.
Rainfall Interception on a Small Forested Watershed within the Kawartha Lakes Region,
W85-04578 2I

TAYLOR, M.
Drier Sludge Ends Landfill Leaching Concerns,
W85-04650 5D

TAYLOR, R. H.
Bacterial Colonization of Point-of-Use Water Treatment Devices,
W85-04834 5F

TEDROW, J. C. F.
Pedologic Properties of New Jersey Tidal Marshes,
W85-04955 2L

TEJWANI, K. G.
Reservoir Sedimentation in India – Its Causes, Control, and Future Course of Action,
W85-04439 6G

TENCH, H. B.
Use of Performance Indicators in Sewage Treatment Appraisal,
W85-04510 5D

TENGERDY, R. P
Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

TESSIER, A.
Accumulation of Copper and Zinc in the Yellow Water Lily, Nuphar variegatum: Relationships to Metal Partitioning in the Adjacent Lake Sediments,
W85-04837 5B

Trace Metals in Oxic Lake Sediments: Possible Adsorption onto Iron Oxyhydroxides,
W85-04757 5B

THAIN, J. E.
Effects of Mercury on the Prosobranch Mollusc Crepidula fornicata: Acute Lethal Toxicity and Effects on Growth and Reproduction of Chronic Exposure,
W85-04867 5C

THIESSE, B. R.
Relationships among Oxygen Flux, Soil Water Tension, and Aeration Porosity in a Drying Soil Profile,
W85-04956 2G

THOMAS, W.
Behaviour of Organic Micropollutants (PAH, PCB, and BHC) and of a Fecal Sterol in the Husum Estuary and in the Adjacent North Frisian Wadden Sea (Verhalten organischer Umweltchemikalien (PCA, PCB und HCH) und eines fakalen Sterols in der Husumer Aue und auf den angrenzenden Wattern - Nordfriesland),
W85-04808 5B

THOMPSON, P. A.
Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
W85-04875 5C

THURMAN, V. C.
Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

TIDSWELL, M. A.
Industrial Effluent Treatment at Sewage-Treatment Works: The Tadcaster Experience,
W85-04521 5D

TIRAVANTI, G.
Influence of the Charge Density of Cationic Polyelectrolytes on Sludge Conditioning,
W85-04494 5D

TISUE, T.
Preconcentration of Submicrogram Amounts of Metals from Natural Waters for X-ray Energy Spectrometric Determination Using Pyrrolidinecarbodithioic Acid,
W85-04621 5A

TODD, R. L.
Nutrient Budgets for Agricultural Watersheds in the Southeastern Coastal Plain,
W85-04826 6G

TOERIEN, D. F.
Microbial Heterotrophic Activity Assessment in a Waste-water Treatment System,
W85-04706 5D

Temperature-Growth Rate Relationships of Aerobic Heterotrophic Bacteria Isolated from a Silt-laden Impoundment,
W85-04815 2H

TOKOS, J. J. JR.
Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

TOMASSO, J. R.
Confinement and Water Quality-Induced Stress in Largemouth Bass,
W85-04680 5C

TOMASZEWICZ, H.
Typhetum angustifoliae and Typhetum latifoliae as Indicators of Various Habitats,
W85-04614 2L

TOPPING, J. J.
Organochlorine Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04437 5B

Trace Metal Residues in Shellfish from Maryland Waters, 1976-1980,
W85-04436 5B

TOTH, J.
Two-Phase Anaerobic Fermentation of Liquid Swine Waste to Methane,
W85-04659 5D

TOTH, I.
Microelement Content of Some Submerged and Floating Aquatic Plants,
W85-04678 2H

TOUSSAINT, B.
Main Results of a Project for Artificial Ground-Water Recharge from Secondarily Treated Sewage in the Municipal Forest of the City of Langen (Lower Main Region) (Die wichtigsten Ergebnisse eines Projektes zur kunstlichen Grundwasser-anreicherung mit weitergehend behandeltem Abwasser im Langener Stadtwald (Untermainregion)),
W85-04809 5D

TRAMONTANO, J. M.
Wet Deposition of Trace Metals to the Western Atlantic Ocean at the Mid-Atlantic Coast and on Bermuda,
W85-04504 5B

TREVORS, J. T.
Effect of Methylene Chloride on Respiration and Electron Transport System (ETS) Activity in Freshwater Sediment,
W85-04475 5C

TRISAL, C. L.
Sediment Composition, Mud-water Interchanges and the Role of Macrophytes in Dal Lake, Kashmir,
W85-04904 2H

TRIVEDY, R. K.
Influence of Water Hyacinth Cover on the Physico-Chemical Characteristics of Water and Phytoplankton Composition in a Reservoir near Jaipur (India),
W85-04913 5C

TROLLOPE, D. R.
Sewage-Derived Bacteria Monitored in a Marine Water Column by Means of Captive Mussels,
W85-04868 5A

TSUCHINAGA, T.
Metals and Synthetic Organic Compounds in Plankton from the Estuary and Harbor Area in Osaka City,
W85-04607 5A

TUNDISI, J. G.
Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

TURNER, A. H.
Biodegradability of Two Primary Alcohol Ethoxylate Nonionic Surfactants Under Practical Conditions, and the Toxicity of the Biodegradation Products to Rainbow Trout,
W85-04487 5D

UDOIMUK, A. B.
Comparative Studies of NO3- Concentrations in Some Tropical Rains,
W85-04506 5B

UNNI, K. S.
Primary Production and Diuranal Variation in a Tropical Fish Pond,
W85-04852 5C

URBAN, J. B.
Effect of Agricultural Land Use on Ground-Water Quality in a Small Pennsylvania Watershed,
W85-04642 5B

UTTORMARK, P. D.
Cellular Phosphorus Concentration as a Criterion for Trophic Status in Rapidly Flushed Lakes,
W85-04846 2H

VALLI, V. E.
Subchronic Effects of a Mixture of 'Persistent' Chemicals Found in the Great Lakes,
W85-04479 5C

VAN COILLIE, R.
Evaluation of Ecological Forecasting Previous to the Hydroelectric Development of a Natural Subarctic Reservoir (Evaluation et Prevision Ecologique Prealable a L'Amenagement Hydroelectrique D'Un Reservoir Naturel Hemiarctique),
W85-04575 6G

VAN DEN BERG, C. M. G.
Determining Trace Concentrations of Copper in Water by Cathodic Film Stripping Voltammetry With Adsorptive Collection,
W85-04410 5A

VAN DER HEIDE, J.
Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04898 5A

VAN LEEUWEN, C. J.
Aquatic Toxicity of 2,6-Dichlorobenzamide (BAM), a Degradation Product of the Herbicide Dichlobenil,
W85-04944 5C

VAN LIEPE, L.
Loosdrecht Lakes Restoration Project, an Introduction,
W85-04544 2H

VANT, W. N.
Factors Affecting Clarity of New Zealand Lakes,
W85-04670 2H

VANZYL, H. J.
Sensitivity of Stone Fruit Rootstocks to Waterlogging,
W85-04812 2I

VARANASI, U.
Simultaneous Exposure of English Sole (Parophrys vetulus) to Sediment-Associated Xenobiotics: Part 1 - Uptake and Disposition of 14C-Polychlorinated Biphenyls and 3H-Benzo(a)Pyrene,
W85-04870 5C

VARMA, S.
Simultaneous Determination of Zinc and Chromate in Cooling Water by Differential Pulse Polarography,
W85-04624 5A

VEALE, B. J.
Floodplain Policy and Practice in the Credit River Watershed, Ontario,
W85-04587 6F

VERDOUW, H.
Carbon Mineralization in Microaerobic and Anaerobic Strata of Lake Vechten (The Netherlands): Diffusion Flux Calculations and Sedimentation Measurements,
W85-04702 2H

VERMES, L.
Wastewater Disposal and Utilization in Agriculture in Poland and Hungary,
W85-04664 5E

VERSCHUREN, J. P.
Interflow Model: I. Model Development,
W85-04577 2A

Interflow Model: II. Model Validation,
W85-04579 2A

VIGNESWARAN, S.
Influence of Suspended Particle Size Distribution in Deep-Bed Filtration,
W85-04876 5F

Optimization of Sand Recycle Rate in Mobile Bed Filtration,
W85-04663 5F

VILLENEUVE, D. C.
Subchronic Effects of a Mixture of 'Persistent' Chemicals Found in the Great Lakes,
W85-04479 5C

VINCENT, C. L.
Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

VINCENT, W. F.
Nitrate Cycling in Lake Titicaca (Peru-Bolivia): The Effects of High-Altitude and Tropicality,
W85-04896 2H

VISVANATHAN, C.
Optimization of Sand Recycle Rate in Mobile Bed Filtration,
W85-04663 5F

VOERMAN, J.
Size Classes of 'Dissolved' Nutrients in Shallow, Alkaline, Humic and Eutrophic Tjeukemeer, The Netherlands, as Fractionated by Ultrafiltration,
W85-04550 2K

VON BERNUTH, R. D.
Sprinkler Droplet Size Distribution Estimation from Single Leg Test Data,
W85-04745 8C

VUKOVIC, Z.
Some Characteristics of Chemical Crystallization in Water Purification Process,
W85-04409 5F

VYMAZAL, J.
Short-Term Uptake of Heavy Metals by Periphyton Algae,
W85-04721 5B

WAI, C. M.
Dithiocarbamate Extraction of Gallium from Natural Waters and from Biological Samples for Neutron Activation Analysis,
W85-04961 5A

WALDICHUK, M.
Biological Availability of Metals to Marine Organisms,
W85-04891 5B

WALLEN, D. G.
Seasonal Variation of Nutrient Limitation in Western Lake Erie,
W85-04719 2H

WALTHER, H.
Qualitative and Quantitative Entomofaunistic Investigation of an Opencast Residual Lake near Leipzig (GDR),
W85-04906 2H

WANGEN, L. E.
Attenuation of Chemical Elements in Acidic Leachates from Coal Mineral Wastes by Soils,
W85-04600 5B

WARD, A. D.
Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

WARNER, R. C.
Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

WARR, E.
Changes in the Extractabilities of the Heavy Metals in Water-Logged Sludge-Treated Soils,
W85-04514 5E

WEBSTER, J. J.
Determination of Microbial Cell Numbers in Subsurface Samples,
W85-04636 5A

WEBSTER, J. R.
Shredder Abundance and Leaf Breakdown in an Appalachian Mountain Stream,
W85-04899 2H

WELSTED, J.
Garrison Diversion Unit - An Update,
W85-04574 4A

WEST, J. R.
Evaluation of a Moving-Co-ordinate System Model of Salinity Intrusion into the Mersey Estuary,
W85-04528 2L

Note on the Prediction of Dissolved Oxygen Concentration in Estuaries,
W85-04529 2L

WESTALL, J. C.
Influence of pH and Ionic Strength on the Aqueous-Nonaqueous Distribution of Chlorinated Phenols,
W85-04803 5B

WESTERHOFF, G. P.
Privatization Needs the Professional Approach,
W85-04954 6A

WHARTON JR, R. A.
Thickness of Ice on Perennially Frozen Lakes,
W85-04883 2C

WHEELER, R. A.
Controlling Sewage Treatment Plant Odours,
W85-04769 5D

WHITE, D. H.
Bird Use and Heavy Metal Accumulation in Waterbirds at Dredge Disposal Impoundments, Corpus Christi, Texas,
W85-04480 5B

WHITE, J. W. C.
D/H Ratios of Sap in Trees: Implications for Water Sources and Tree Ring D/H Ratios,
W85-04758 2I

WHITE, R. E.
Availability to Plants of Phosphate in Sludges Precipitated from the Effluent from Sewage Treatment,
W85-04597 5E

WHITE, W. R.
Health and Amenity Aspects of Surface Waters,
W85-04457 5G

WHITELY, H. R.
Effects of Land Drainage on Stream Flow,
W85-04583 4C

WIGGLESWORTH, A. F.
Water Utility in the Nuclear Age,
W85-04773 5B

WILLCOCKS, R. J.
Sewage Plant Provides Energy for District Heating System,
W85-04770 5D

WILLIAMSON, S.
Accelerated Cold Digestion: A New Look at an Old Technique,
W85-04591 5D

WILLIS, M.
Comparative Survey of the Erpobdella octoculata (L.) Populations in the Afon Crafnant, N. Wales, Above and Below an Input of Zinc from Mine-Waste,
W85-04886 5C

WILLSON, W. G.
Gasifier Wastewater Treatment: Phase I Cooling Tower Assessment,
W85-04879 5D

WILSON, B. N.
Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

Sediment Detention Pond Model Using CSTRS Mixing Theory,
W85-04731 5E

WILSON, G. V.
Relationships among Oxygen Flux, Soil Water Tension, and Aeration Porosity in a Drying Soil Profile,
W85-04956 2G

WILSON, J. T.
Determination of Microbial Cell Numbers in Subsurface Samples,
W85-04636 5A

WILSON, K. C.
Bowhouse Sewerage and Sewage Disposal Scheme of Fife Regional Council,
W85-04508 5D

WILSON, R. S.
Monitoring of River Water Quality within the Great Ouse Basin Using the Chironomid Exuvial Analysis Technique,
W85-04454 5A

WINNER, R. W.
Acute Toxicity of Copper to Three Life Stages of Chrionomus tentans as Affected by Water Hardness-Alkalinity,
W85-04946 5C

WISNIEWSKI, R.
External and Internal Loading and Retention of Phosphorus in the R. Jorka Lakes (Masurian Lakeland, Poland) vs Their Trophic Status,
W85-04556 2H

WISSELO, A. G.
Loosdrecht Lakes Restoration Project: Sediment Phosphorus Distribution and Release from the Sediments,
W85-04546 2K

WONG, I.
Commercial Mining Technique Offers a New Approach to Removing Heavy Metals from Sludges,
W85-04767 5D

WOODARD, G. C.
Arizona Water Issues: Contrasting Economic and Legal Perspectives,
W85-04756 6E

WOODS, D. R.
Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

WOODS, P. E.
Acute Toxicity of Copper to Three Life Stages of Chrionomus tentans as Affected by Water Hardness-Alkalinity,
W85-04946 5C

WOODWARD, G. M.
Pollution Control in the Humber Estuary,
W85-04453 5G

WORTHINGTON, J. W.
Stomatal Responses to Leaf Water Potentials of Drip Irrigated Peach (Prunus persica),
W85-04746 2I

WRATTEN, F. T.
Hydraulic Conductivity Measured Electronically in an Auger Hole,
W85-04740 2G

WU, D.
Sedimentation Problem in Water Conservancy in China,
W85-04446 4D

WU, X.
Large Hydropower Stations in China,
W85-04951 6B

WURSTER, C. F.
PCB Resistance within Phytoplankton Populations in Polluted and Unpolluted Marine Environments,
W85-04864 5C

WYMAN, R. L.
Factors Influencing Impingement of Fish by Lake Ontario Power Plants,
W85-04713 8I

XU, S.
Determination of Trace Amounts of Heavy Metals in Waters by a Flow-Injection System Including Ion-Exchange Preconcentration and Flame Atomic Absorption Spectrometric Detection,
W85-04653 5A

YAKOWITZ, S.
Markov Flow Models and the Flood Warning Problem,
W85-04795 2E

YAMOCHI, S.
Inorganic Nutrients Occurring in the Oxygen-deficient Bottom Water of Osaka Bay,
W85-04606 2K

YANDLE, B.
Environmental Control and Regional Growth,
W85-04755 6G

YEE, A.
Study of Water Bleeder Control Alternatives,
W85-04922 3D

YEH, T.-C.
Galerkin Finite-Element Program for Simulating Unsaturated Flow in Porous Media,
W85-04645 2F

YOO, J. Y.
Dissipation of Permethrin in Limnocorrals,
W85-04838 5B

YOUNG, R. A.
Effects of Electricity Rates and Rate Structures on Pump Irrigation: An Eastern Colorado Case Study,
W85-04752 3F

Method of Measuring Aggregate Stability Under Waterdrop Impact,
W85-04733 2J

YU, J. C.
Dithiocarbamate Extraction of Gallium from Natural Waters and from Biological Samples for Neutron Activation Analysis,
W85-04961 5A

ZAMORANO, D.
Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance,
W85-04907 2L

ZANON, G.
Availability of Sediment P in Lake Lugano,
W85-04563 2H

ZARTMAN, R. E.
Saline Irrigation Water: Effects on Soil Chemical and Physical Properties,
W85-04618 3C

ZHANG, S.
Determination of Trace Amounts of Heavy Metals in Waters by a Flow-Injection System Including Ion-Exchange Preconcentration and Flame Atomic Absorption Spectrometric Detection,
W85-04653 5A

ZHANG, X.
Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

ZHENG, N.
Medium and Small Masonry Arch Dams in China,
W85-04950 8A

ZIMMERMANN, R.
Degradation of Macromolecular Organic Compounds in a Tropical Lagoon (Cienaga Grande, Colombia) and its Ecological Significance,
W85-04907 2L

ZINGMARK, R. G.
Oyster Reefs as Processors of Estuarine Materials,
W85-04483 2L

ZIRJACKS, W. L.
Underground Utilities in Barrow, Alaska,
W85-04925 6A

ZUCKER, C. L.
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

ZUKOVS, G.
Methodology for Pollution Control Decision Analysis,
W85-04582 5G

ORGANIZATIONAL INDEX

36635 FAIRFIELD ROAD, INGLESIDE, IL 60041.
Migration and Attenuation of Selected Organics in a Sandy Aquifer - A Natural Gradient Experiment,
W85-04635 5B

AARHUS UNIV. (DENMARK). BOTANICAL INST.
Dissolved Organic Carbon in Danish Lakes: Concentration, Composition, and Lability,
W85-04540 5C

ACADEMIA SINICA, QINGDAO (CHINA). INST. OF OCEANOLOGY.
Relationships Between Arsenic and Other Elements (Iron, Aluminium, Manganese etc) in Surface Sediments of Bohai Bay (in Chinese),
W85-04835 2K

ACADEMIA SINICA, SHENYANG (CHINA). INST. OF FORESTRY AND SOIL SCIENCE.
Determination of Trace Amounts of Heavy Metals in Waters by a Flow-Injection System Including Ion-Exchange Preconcentration and Flame Atomic Absorption Spectrometric Detection,
W85-04653 5A

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF APPLIED MATHEMATICS.
Physical Processes and Pollution in the Waters of Spencer Gulf,
W85-04763 2L

ADELAIDE UNIV. (AUSTRALIA). DEPT. OF GEOLOGY AND MINERALOGY.
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W85-04764 5B

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Fluid Transport Processes in Upper Spencer Gulf,
W85-04762 2L

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Rangeland Erosion Measurements for the USLE,
W85-04728 2J

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Stream Water Levels Affect Field Water Tables and Corn Yields,
W85-04726 2F

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Integrated Water-Energy Management System for Center Pivot Irrigation: Functional Requirements,
W85-04742 7C

Integrated Water-Energy Management System for Center Pivot Irrigation: Implementation,
W85-04743 7C

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Evaluation Technique for Ground Water Quality Beneath Urban Runoff Retention and Percolation Basins,
W85-04417 2G

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Water-Table Contribution to Alfalfa Evapotranspiration and Yields in Sandy Soils,
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W85-04826 6G

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Oxygen Injection Cuts Odors,
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Phosphorus in the Bottom Sediments of Some Lakes of the World,
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Study of Water Bleeder Control Alternatives,
W85-04922 3D

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Interflow Model: I. Model Development,
W85-04577 2A

Interflow Model: II. Model Validation,
W85-04579 2A

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Modelling Winter Oxygen Depletion Rates in Ice-Covered Temperate Zone Lakes in Canada,
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W85-04631 8B

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Monitoring of River Water Quality within the Great Ouse Basin Using the Chironomid Exuvial Analysis Technique,
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Cost-Effective Management - Revenue and Technical Monitoring,
W85-04519 6B

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Markov Flow Models and the Flood Warning Problem,
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Relationships among Oxygen Flux, Soil Water Tension, and Aeration Porosity in a Drying Soil Profile,
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Dispersion Model for Waste Stabilization Ponds,
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W85-04808 5B

BEAVERCREEK WASTEWATER TREATMENT FACILITY, OH.
Doing a Job on Data,
W85-04651 7C

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Evaluation of a Moving-Co-ordinate System Model of Salinity Intrusion into the Mersey Estuary,
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Note on the Prediction of Dissolved Oxygen Concentration in Estuaries,
W85-04529 2L

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Garrison Diversion Unit - An Update,
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Experimental Marine Ecosystem Response to Crude Oil and Corexit 9527: Part 2 - Biological Effects,
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Computing Degradation and Local Scour,
W85-04934 2J

Parker Dam Concrete Core Investigations,
W85-04935 8F

Fly Ash and Fly Ash Concrete,
W85-04936 8F

Stewart Mountain Dam Concrete Core Analysis - 1983,
W85-04938 8A

Water Quality of the Colorado River System: Historical Trends in Concentration Load, and Mass Fraction of Inorganic Solutes,
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Capillary Gas Chromatography Determination of Volatile Organic Acids in Rain and Fog Samples,
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W85-04569 2H

CALIFORNIA UNIV., SANTA CRUZ. DEPT. OF EARTH SCIENCES.
Sediment Storage and Terrace Formation in Coyote Gulch Basin, South-Central Utah,
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Canadian Water Management: A One Armed Giant,
W85-04685 6A

Copper Complexation and Toxicity to Daphnia in Natural Waters,
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W85-04766 6E

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W85-04818 2H

CEH INGENIEROS CONSULTORES, CARACAS (VENEZUELA).
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W85-04783 8A

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Bioturbation and Microbial Activity,
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Removing Giardia Cysts with Slow Sand Filtration,
W85-04831 5F

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Evolution of the Community at a Station Exposed to Sewage (Marseille-Cortiou) (Evolution Du Peuplement D'une Station Soumise A Des Apports D'Eaux D'Egout (Marseille-Cortiou)),
W85-04709 5C

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Effect of Drain Tube Openings on Drainage and Subirrigation,
W85-04748 4A

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Quiescence, Growth and Senescence of Egeria densa in Lake Marion,
W85-04858 2H

CLEMSON UNIV., SC. DEPT. OF ECONOMICS.
Environmental Control and Regional Growth,
W85-04755 6G

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Heating Enclosed Wastewater Treatment Facilities with Heat Pumps,
W85-04924 6A

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W85-04937 5C

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W85-04805 7B

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W85-04443 4D

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Availability of Sediment P in Lake Lugano,
W85-04563 2H

Importance of Macrophytes in Two Lakes with Different Trophic Degree: Lake Comabbio and Lake Monate (Province of Varese, Northern Italy),
W85-04564 2H

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W85-04723 2H

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W85-04489 5D

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W85-04730 5D

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W85-04839 2K

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Closed Formulae for Earthquake-Induced Deformations in Dams,
W85-04782 8D

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Investigation into the Hydraulic Resources of a Lagoon in Portugal,
W85-04461 5G

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W85-04541 5C

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W85-04786 4A

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W85-04885 5C

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W85-04433 5A

Responses of Lake Whitefish (Coregonus clupeaformis) to Fertilization of Lake 226, the Experimental Lakes Area,
W85-04840 8I

Gas Supersaturation as a Cause of Early Spring Mortality of Stocked Trout,
W85-04844 2H

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Utilities Delivery for the Indian and Inuit Affairs Program,
W85-04916 6B

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Cost Sharing in a Multipurpose Water Project,
W85-04778 6C

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Thermal Treatment 'Energizes' San Mateo Sludge,
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Need for Chemical Phosphate Removal,
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Hydraulic Modelling at the Piedra del Aguila Dam,
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Evaluating Sedimentation and Various Filter Media for Removal of Giardia Cysts,
W85-04832 5F

Bacterial Colonization of Point-of-Use Water Treatment Devices,
W85-04834 5F

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W85-04830 5F

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Water Conservation in the Northwest Territories - Public Education and Awareness Program,
W85-04920 3D

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W85-04941 5B

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W85-04775 5C

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W85-04687 6C

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W85-04696 5C

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W85-04482 2K

Geochemical Behavior of Inorganic Germanium in an Unperturbed Estuary,
W85-04760 2K

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W85-04853 2I

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W85-04887 2H

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W85-04812 2I

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W85-04955 2L

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Acceptance of Treated Water by Northern Community Residents,
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W85-04587 6F

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Dissipation of Permethrin in Limnocorrals,
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Dithiocarbamate Extraction of Gallium from Natural Waters and from Biological Samples for Neutron Activation Analysis,
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Estimating the Parameters of a Cube Root Normal Distribution from Reduced Sample Data,
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Removal of New Indicators by Coagulation and Filtration,
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Sampling Tubing Effects on Groundwater Samples,
W85-04655 7B

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Giardia Lamblia and Water Supply,
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Determining Trace Concentrations of Copper in Water by Cathodic Film Stripping Voltammetry With Adsorptive Collection,
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W85-04738 2G

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W85-04740 2G

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W85-04842 2H

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W85-04861 5B

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Comparison of Leaching Losses from Decomposing Litter of the Terrestrial and Marsh Plants on Land and in Water,
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Methanogenesis in Sediments of Eutrophic Lakes; 2. Comparative Investigations on the Methane-Precursor Preference,
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Seasonal Variation of the Major Cation Content of the Varzea-Lake Lago Camaleao, Middle Amazon, Brazil, in 1981 and 1982,
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Multiphase Approach to the Modeling of Porous Media Contamination by Organic Compounds; 2. Numerical Simulation,
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Performance of Grass Filters Under Laboratory and Field Conditions,
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MISSOURI UNIV.-COLUMBIA. DEPT. OF AGRICULTURAL ENGINEERING.
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1981 CCOPE PROBE Mesonet Calibration and Maintenance Measures,
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Trace Metal-Binding Proteins in Marine Molluscs and Crustaceans,
W85-04873 5C

NATIONAL MARINE FISHERIES SERVICE, CHARLESTON, SC. SOUTHEAST FISHERIES CENTER.
Simultaneous Accumulations of Naphthalene, a PCB Mixture, and Benzo(a)pyrene, by the Oyster, Crassostrea virginica,
W85-04477 5B

NATIONAL MARINE FISHERIES SERVICE, SEATTLE, WA. NORTHWEST AND ALASKA FISHERIES CENTER.
Simultaneous Exposure of English Sole (Parophrys vetulus) to Sediment-Associated Xenobiotics: Part 1 - Uptake and Disposition of 14C-Polychlorinated Biphenyls and 3H-Benzo(a)Pyrene,
W85-04870 5C

NATIONAL RESEARCH CENTRE, CAIRO (EGYPT). WATER POLLUTION CONTROL LAB.
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W85-04473 5B

NATIONAL RESEARCH COUNCIL OF CANADA, HALIFAX (NOVA SCOTIA). ATLANTIC RESEARCH LAB.
Application of Ion-Exchange Chromatography with an Ion-Selective Electrode Detector to Iodine Determination in Natural Waters,
W85-04654 5A

NATIONAL SWEDISH ENVIRONMENT PROTECTION BOARD, SOLNA.
Fractionation of Trace Metals in Acidified Fresh Waters by in situ Dialysis,
W85-04535 5B

NATIONAL UNIV. OF SINGAPORE. DEPT. OF ZOOLOGY.
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W85-04708 5C

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
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W85-04714 2H

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). ENVIRONMENTAL CONTAMINANTS DIV.
Tracking River Plumes with Volatile Halocarbon Contaminants: The Niagara River-Lake Ontario Example,
W85-04715 5B

NEANDESTRE. 23, 1000 BERLIN 49.
Determination of Spreading of Nutritive Salts in Quasi-Stagnant Waters by Using Lithium (Chloride) as Tracer and Continuous Measurement of Water-Quality Parameters (Die Bestimmung von Ausbreitungsvorgangen von Nahrsalzen in quasi stehenden Gewassern unter Verwendung des Tracers Lithium (Chlorid) und die kontinuierliche Messung von Wasserguteparametern),
W85-04810 5A

NEBRASKA UNIV., LINCOLN. CONSERVATION AND SURVEY DIV.
Ground-Water Contamination and Well Construction in Southeast Nebraska,
W85-04637 5B

NEBRASKA UNIV., LINCOLN. DEPT. OF AGRICULTURAL ENGINEERING.
Tillage Influences on Erosion During Furrow Irrigation,
W85-04749 4C

NEW HAMPSHIRE UNIV., DURHAM.
Time Series Models for Treatment of Surface Waters,
W85-04965 5F

NEW HAMPSHIRE WATER SUPPLY AND POLLUTION CONTROL COMMISSION, CONCORD.
Dispersion Modeling of Multiple Sources Using the HP-41CV,
W85-04644 5B

NEW MEXICO INST. OF MINING AND TECHNOLOGY, SOCORRO. DEPT. OF GEOSCIENCE.
Galerkin Finite-Element Program for Simulating Unsaturated Flow in Porous Media,
W85-04645 2F

Field Method to Determine Unsaturated Hydraulic Conductivity Using Flow Nets,
W85-04791 2G

NEW ORLEANS UNIV., LA. CENTER FOR BIO-ORGANIC STUDIES.
Volatile Organic Pollutants in Biota and Sediments of Lake Pontchartrain,
W85-04476 5A

NEW YORK BOTANICAL GARDEN, BRONX, NY.
Long-Term Trends in Precipitation Chemistry at Hubbard Brook, New Hampshire,
W85-04502 5B

NEW YORK STATE COLL. OF AGRICULTURE AND LIFE SCIENCES, ITHACA.
Biodegradation of Organic Chemicals,
W85-04797 5B

NEW YORK STATE COLL. OF HUMAN ECOLOGY, ITHACA. DEPT. OF DESIGN AND ENVIRONMENTAL ANALYSIS.
Nitrate Contamination: Public Awareness,
W85-04828 5F

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Toxicologic Studies Associated with the Agricultural Use of Municipal Sewage Sludge and Health Effects among Sewage Treatment Plant Workers,
W85-04776 5E

NEW YORK UNIV., NY. DEPT. OF BIOLOGY.
Heavy Metal Toxicity to Microbe-Mediated Ecologic Processes: A Review and Potential Application to Regulatory Policies,
W85-04435 5C

NORGES LANDBRUKSHOEGSKOLE, AAS. DEPT. OF AGRICULTURAL HYDROTECHNICS.
Conceptual Model of Lake Acidification,
W85-04531 5C

NORGES TEKNISKE HOEGSKOLE, TRONDHEIM. DEPT. OF GEOLOGY.
Unlined High Pressure Tunnels in Areas of Complex Topography,
W85-04412 8A

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W85-04532 5C

NORSK POLARINSTITUTT, OSLO.
Concentrations of Seabirds Along the Face of Glaciers and Outlets of Rivers in Svalbard (Konsentrasjoner av sjofugl langs kanten av isbreer og utenfor breelver pa Svalbard),
W85-04608 2L

NORTH CANTERBURY CATCHMENT BOARD, CHRISTCHURCH (NEW ZEALAND).
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W85-04724 2H

NORTH DAKOTA STATE UNIV., FARGO. DEPT. OF AGRICULTURAL ECONOMICS.
Proposed Framework for Developing a Multidisciplinary Wetlands Valuation Model,
W85-04684 2L

NORTH DAKOTA UNIV., GRAND FORKS. ENERGY RESEARCH CENTER.
Gasifier Wastewater Treatment: Phase I Cooling Tower Assessment,
W85-04879 5D

NORTH WEST WATER AUTHORITY, WARRINGTON (ENGLAND).
Present Techniques for 'In-Situ' Sewer Renovation,
W85-04518 8F

Destruction of Pathogens and Parasites in Sewage Sludge by Chemical Means,
W85-04592 5E

NORTH WEST WATER AUTHORITY, WARRINGTON (ENGLAND). RIVERS DIV.
Effects of Motorway Run-Off on the Ecology of Stream Algae,
W85-04466 5C

NORTHEASTERN UNIV., BOSTON, MA. DEPT. OF EARTH SCIENCES.
Human Modification of Molluscan Habitats in Little Creek Estuary, Virginia,
W85-04859 6G

NORTHERN TESTING LAB., INC., FAIRBANKS, AK.
Water Conservation in Barrow, Alaska,
W85-04918 6B

NORTHUMBRIAN WATER AUTHORITY, GOSFORTH (ENGLAND).
Pollution Control Policies for the Tees Estuary,
W85-04525 5G

NORWEGIAN HYDRODYNAMIC LABS., TRONDHEIM.
Underwater Piercing of a Tunnel,
W85-04415 8A

NORWEGIAN LIMING PROJECT, ARENDAL.
Efficiency of Liming in Acid, Humus-Influenced Lakes,
W85-04533 5G

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
Inventories and Sorption-Desorption Trends of Radiocesium and Radiocobalt in James River Estuary Sediments,
W85-04601 5B

OCCIDENTAL COLL., LOS ANGELES, CA. DEPT. OF BIOLOGY.
Effects of Dechlorinated Seawater on Fish Behavior,
W85-04862 5D

OHIO STATE UNIV., COLUMBUS. DEPT. OF AGRICULTURAL ECONOMICS AND RURAL SOCIOLOGY.
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W85-04447 4D

OKAYAMA UNIV. (JAPAN). DEPT. OF PUBLIC HEALTH.
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W85-04496 5C

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRICULTURAL ENGINEERING.
Sediment Detention Pond Model Using CSTRS Mixing Theory,
W85-04731 5E

Hydrology and Sedimentology Watershed Model. Part I: Operational Format and Hydrologic Component,
W85-04735 2A

Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component,
W85-04736 2A

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W85-04636 5A

ONTARIO HYDRO, TORONTO.
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W85-04584 5B

ONTARIO HYDRO, TORONTO. RESEARCH DIV.
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W85-04914 8I

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF BOTANY.
Specific Ultraviolet Absorbance Band of Microcystis aeruginosa Toxins,
W85-04816 5A

Leaf Area as a Measure of Standing Crop of Floating Aquatic Macrophytes,
W85-04817 2H

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W85-04815 2H

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W85-04803 5B

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W85-04827 2J

OREGON STATE UNIV., CORVALLIS. SCHOOL OF OCEANOGRAPHY.
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W85-04712 2K

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W85-04622 5A

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W85-04606 2K

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W85-04530 5A

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W85-04560 5B

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W85-04869 5C

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W85-04668 2H

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W85-04915 6B

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W85-04597 5E

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W85-04514 5E

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W85-04480 5B

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W85-04753 6B

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W85-04505 5B

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W85-04413 8A

PIRNIE (MALCOLM), INC., WHITE PLAINS, NY.
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W85-04954 6A

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W85-04691 3D

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W85-04556 2H

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W85-04558 2H

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W85-04780 6A

PRETORIA UNIV. (SOUTH AFRICA). DEPT. OF AGRICULTURAL ENGINEERING.
Convert the Brook on Your Farm to Electric Current,
W85-04813 8C

PROGRAMME INTERDISCIPLINAIRE DE RECHERCHE SUR L'ENVIRONNEMENT - PR2 RHONE.
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W85-04889 5G

Changes of Organic and Inorganic Nitrogen in a Polluted Brook-Pond System During an Aeration Experiment (Veranderingen in de Organische en Anorganische Stikstof van een Bevuild Beek-Vijverwater Gedurende een Aeratie-Experiment),
W85-04890 5G

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W85-04683 5G

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W85-04717 5C

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W85-04857 5G

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W85-04488 7B

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W85-04761 2K

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W85-04453 5G

Lea Marston Purification Lake: Operational and River-Quality Aspects,
W85-04458 5G

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W85-04460 5G

Problems Associated with the Disposal of Trade Effluent to Sewers - Charging and Control,
W85-04463 5E

Optimization of Coleshill Activated-Sludge Plant Operating Conditions,
W85-04590 5D

Aerobic Treatment in 'Oxitron' Biological Fluidized Bed Plant at Coleshill,
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W85-04450 2L

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W85-04963 5F

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W85-04616 5B

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W85-04864 5C

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W85-04872 5C

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W85-04849 2H

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W85-04952 8G

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W85-04756 6E

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W85-04968 5D

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W85-04793 2F

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W85-04745 8C

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W85-04618 3C

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Responses of the Phytoplankton Community of a Tropical Reservoir (Sao Paulo, Brazil) to the Enrichment with Nitrate, Phosphate and EDTA,
W85-04908 2H

UNIVERSIDADE FEDERAL DO RIO DE JANEIRO (BRAZIL). INST. DE BIOFISICA.
Mineral Distribution and Ecological Role of a Recently Formed Halophyte Community in the Guanabara Bay Rio De Janeiro,
W85-04851 5C

UNIVERSITY COLL. OF SWANSEA (WALES). DEPT. OF BOTANY AND MICROBIOLOGY.
Sewage-Derived Bacteria Monitored in a Marine Water Column by Means of Captive Mussels,
W85-04868 5A

UNIVERSITY OF AGRICULTURE, GODOLLO (HUNGARY).
Wastewater Disposal and Utilization in Agriculture in Poland and Hungary,
W85-04664 5E

UNIVERSITY OF EAST ANGLIA, NORWICH (ENGLAND). SCHOOL OF ENVIRONMENTAL SCIENCES.
Rainborne SO2, Precipitation pH and Airborne SO2 Over Short Sampling Times Throughout Individual Events,
W85-04500 5B

UNIVERSITY OF SOUTHWESTERN LOUISIANA, LAFAYETTE. DEPT. OF BIOLOGY.
Effects of Soil Waterlogging on the Energy Status and Distribution of Salix nigra and S. exigua (Salicaceae) in the Atchafalaya River Basin of Louisiana,
W85-04943 2I

UPPSALA UNIV. (SWEDEN). INST. OF ZOOPHYSIOLOGY.
Toxicity of Effluents from a TiO2 Plant to the Harpacticoid Copepod Nitocra spinipes Boeck,
W85-04866 5C

UPPSALA UNIV. (SWEDEN). LIMNOLOGISKA INSTITUTIONEN.
Experimental Lake Fertilization: Turnover of Nitrogen and Phosphorus in Stratified and Non-Stratified Subarctic Lakes in Northern Sweden,
W85-04534 2H

Variation of Water Quality Parameters in Meso- to Hypereutrophic Lakes,
W85-04536 2H

Experimental Lake Fertilization in the Kuokkel Area, Northern Sweden. Phytoplankton Biomass and Algal Composition in Natural and Fertilized Subarctic Lakes,
W85-04910 2H

UTAH STATE UNIV., LOGAN. DEPT. OF FISHERIES AND WILDLIFE.
Fire and Herbivory in a Great Salt Lake Marsh,
W85-04825 2L

VICTORIA MINISTRY FOR CONSERVATION, QUEENSCLIFF (AUSTRALIA). MARINE SCIENCE LABS.
Suspended Sediments and Nutrients in Water Ebbing from Seagrass-Covered and Denuded Tidal Mudflats in a Southern Australian Embayment,
W85-04856 2L

VICTORIA UNIV. (BRITISH COLUMBIA). DEPT. OF BIOLOGY.
Periphyton Community Changes Along a Heavy Metals Gradient in a Long Narrow Lake,
W85-04860 5C

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. CENTER FOR ENVIRONMENTAL STUDIES.
Protozoan Colonization Rates and Trophic Status of Some Freshwater Wetland Lakes,
W85-04657 2H

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRICULTURAL ECONOMICS.
Opportunity Costs of Preserving Coastal Wetlands: A Case Study of a Recreational Housing Development,
W85-04754 6B

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF AGRONOMY.
Comparison of Field- and Laboratory-Measured and Predicted Hydraulic Properties of a Soil with Macropores,
W85-04617 2G

VIRGINIA POLYTECHNIC INST. AND STATE UNIV., BLACKSBURG. DEPT. OF BIOLOGY.
Shredder Abundance and Leaf Breakdown in an Appalachian Mountain Stream,
W85-04899 2H

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF CHEMISTRY.
Scheme for the Direct Analysis of Organics in the Environment by Tandem Mass Spectrometry,
W85-04656 5A

VIRGINIA UNIV., CHARLOTTESVILLE. DEPT. OF ENVIRONMENTAL SCIENCES.
Organic Acidity in Precipitation of North America,
W85-04499 5B

Composition of Precipitation on Amsterdam Island, Indian Ocean,
W85-04503 5B

Modeling the Effects of Acid Deposition: Assessment of a Lumped Parameter Model of Soil Water and Streamwater Chemistry,
W85-04792 5C

VRIJE UNIV., AMSTERDAM (NETHERLANDS). BIOLOGICAL LAB.
Effects of Phosphorus and Nitrogen Enrichment on the Yield of Some Strains of Stigeoclonium, Kutz. (Chlorophyceae),
W85-04898 5A

VRIJE UNIV., AMSTERDAM (NETHERLANDS). DEPT. OF HYDROGEOLOGY AND GEOGRAPHICAL HYDROLOGY.
Loosdrecht Lakes Restoration Project: Hydrology and Physico-Chemical Characteristics of the Lakes,
W85-04545 2H

VYSOKA SKOLA CHEMICKO-TECHNOLOGICKA, PRAGUE (CZECHOSLOVAKIA). INST. OF WATER TECHNOLOGY AND ENVIRONMENTAL PROTECTION.
Quantitative Estimation in COD Units of Refractory Organic Compounds Produced by Activated Sludge Microorganisms,
W85-04486 5D

Short-Term Uptake of Heavy Metals by Periphyton Algae,
W85-04721 5B

WARSAW UNIV. (POLAND). DEPT. OF ENVIRONMENTAL MICROBIOLOGY.
Phosphatases and Their Role in Organic Phosphorus Transformation in Natural Waters. A Review,
W85-04613 2K

WARSAW UNIV. (POLAND). DEPT .OF PHYTOGEOGRAPHY.
Typhetum angustifoliae and Typhetum latifoliae as Indicators of Various Habitats,
W85-04614 2L

WARSAW UNIV. (POLAND). ZAKLAD FITOSOCJOLOGI I ECOLOGII ROSLIN.
Effect of Anthropogenous Changes of Water Conditions on the Vegetation in the Forest Reserve Las Bielanski in Warsaw (Wplyw antropogennych zmian stosunkow wodnych na roslinnosc rezerwatu Las Bielanski w Warszawie),
W85-04610 4C

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF CIVIL AND ENVIRONMENTAL ENGINEERING.
Comparison of Periphyton Growth on Artificial and Natural Substrates in the Upper Spokane River,
W85-04666 2H

WASHINGTON UNIV., SEATTLE. DEPT. OF CIVIL ENGINEERING.
Biomanipulation Experiment in Green Lake, Seattle, Washington,
W85-04671 5G

WASHINGTON UNIV., SEATTLE. INST. FOR ENVIRONMENTAL STUDIES.
Nutrient Processing in Amazon Floodplain Lakes,
W85-04571 2K

WASHINGTON UNIV., ST. LOUIS, MO. CENTER FOR AIR POLLUTION IMPACT AND TREND ANALYSIS.
Regional River Sulfur Runoff,
W85-04481 5B

WASHINGTON UNIV., ST. LOUIS, MO. DEPT. OF BIOLOGY.
Water Relations of Jamaican Upper Montane Rain Forest Trees,
W85-04824 2I

WASTEWATER TREATMENT PLANT, BREWER, ME.
Drier Sludge Ends Landfill Leaching Concerns,
W85-04650 5D

WATER AUTHORITY HOLLANDSE EILANDEN EN WAARDEN, THE NETHERLANDS.
Industrial Effluent Control in the Netherlands and Legislation in this Field in Some Other European Countries,
W85-04520 5G

WATER RESEARCH CENTRE, MARLOW (ENGLAND).
Solving the Problem of Rehabilitating Decayed Sewer Systems,
W85-04768 8A

WATER RESEARCH CENTRE, SWINDON (ENGLAND). SWINDON ENGINEERING CENTRE.
Prediction and Control of Ground Movement Associated with Trench Excavation,
W85-04516 8D

WATER RESOURCES COMMISSION OF NEW SOUTH WALES, SYDNEY (AUSTRALIA).
Management of Sediment in New South Wales, Australia,
W85-04444 4D

WATER SERVICES, REDHILL (ENGLAND).
Let the Seas Do the Disposal,
W85-04648 5E

WATERLOO REGIONAL MUNICIPALITY (ONTARIO).
Managing Summer Lawn Irrigation Demands: A Water Use Index,
W85-04694 3D

WATERLOO UNIV. (ONTARIO).
Determining Extraneous Flows in Waste Water Systems,
W85-04689 8A

WATERLOO UNIV. (ONTARIO). DEPT. OF CIVIL ENGINEERING.
Zero Side Yard Housing, Acceptance and Stormwater Management Implications,
W85-04580 4A

Methodology for Pollution Control Decision Analysis,
W85-04582 5G

WATERLOO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
River Basin Planning: Problems, Opportunities and Implications for Ontario Conservation Authorities,
W85-04572 6A

Small Format, Hand Held Helicopter Based Photography for Monitoring Industrial Water Effluent Plumes,
W85-04586 7B

WATERLOOPKUNDIG LAB. TE DELFT (NETHERLANDS).
Modelling Eutrophication in Shallow Dutch Lakes,
W85-04551 5C

WATERMEYER, LEGGE, PIESOLD AND UHLMANN, BRAAMFONTEIN (SOUTH AFRICA).
Masinga Dam in Kenya,
W85-04471 8A

WATERMEYER, LEGGE, PIESOLD AND UHLMANN, LONDON (ENGLAND).
Malawi - Driving a 9 m Diameter Power Conduit with Low Cover at Nkula Falls,
W85-04819 8A

WEBER (WERNER) G.M.B.H., PFORZHEIM (GERMANY, F.R.).
'Rennfeld' Small-Scale Hydroelectric Power Plant Near Pforzheim (Kleinwasserkraftanlage 'Rennfeld' bei Pforzheim),
W85-04629 8A

WESSEX WATER AUTHORITY, BRISTOL (ENGLAND).
Pilot-Plant Evaluation of a Deep Shaft Linked to Conventional Aeration Without Inter-Stage Settlement to Give a Fully-Nitrified Effluent,
W85-04452 5D

WESSEX WATER AUTHORITY, POOLE (ENGLAND).
Different Approach to Water Quality Sampling,
W85-04524 5A

WIEDEMAN AND SINGLETON, INC., ATLANTA, GA.
Pure O2 Retrofit Doubles Plant's Capacity,
W85-04953 5D

WILFRID LAURIER UNIV., WATERLOO (ONTARIO).
Role of Pricing in Managing the Demand for Water,
W85-04686 6A

WINDSOR UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Seasonal Variation of Nutrient Limitation in Western Lake Erie,
W85-04719 2H

WISCONSIN UNIV.-MADISON. DEPT. OF SOIL SCIENCE.
Soil Moisture Regimes of Three Conservation Tillage Systems,
W85-04737 2G

WISCONSIN UNIV.-MILWAUKEE. CENTER FOR GREAT LAKES STUDIES.
Preconcentration of Submicrogram Amounts of Metals from Natural Waters for X-ray Energy Spectrometric Determination Using Pyrrolidinecarbodithioic Acid,
W85-04621 5A

Effects of Free and Combined Chlorine and Exposure Duration on Rainbow Trout, Channel Catfish, and Emerald Shiners,
W85-04681 5C

Retrieval of Material from the Surface Microlayer with Screen and Plate Samplers and its Implications for Partitioning of Material within the Microlayer,
W85-04895 5A

WYOMING UNIV., LARAMIE. DEPT. OF BOTANY.
Water and Nutrient Outflow from Contrasting Lodgepole Pine Forests in Wyoming,
W85-04882 2I

WYOMING UNIV., LARAMIE. DEPT. OF ECONOMICS.
Acid Deposition Control, A Benefit-Cost Analysis: Its Prospects and Limits,
W85-04798 6B

YORKSHIRE WATER AUTHORITY (ENGLAND).
Determination of COD by a Mercury-Free Open-Tube Method,
W85-04467 5A

Use of Performance Indicators in Sewage Treatment Appraisal,
W85-04510 5D

Resurrection of Deighton Sewage Treatment Works,
W85-04512 5D

Industrial Effluent Treatment at Sewage-Treatment Works: The Tadcaster Experience,
W85-04521 5D

Accelerated Cold Digestion: A New Look at an Old Technique,
W85-04591 5D

ACCESSION NUMBER INDEX

W85-04409 5F
W85-04410 5A
W85-04411 5D
W85-04412 8A
W85-04413 8A
W85-04414 8F
W85-04415 8A
W85-04416 2E
W85-04417 2G
W85-04418 4C
W85-04419 8B
W85-04420 8A
W85-04421 8B
W85-04422 2J
W85-04423 8C
W85-04424 8B
W85-04425 8F
W85-04426 8A
W85-04427 2J
W85-04428 2E
W85-04429 4A
W85-04430 8D
W85-04431 2K
W85-04432 2L
W85-04433 5A
W85-04434 5C
W85-04435 5C
W85-04436 5B
W85-04437 5B
W85-04438 4D
W85-04439 6G
W85-04440 2J
W85-04441 6B
W85-04442 4D
W85-04443 4D
W85-04444 4D
W85-04445 2J
W85-04446 4D
W85-04447 4D
W85-04448 5C
W85-04449 5F
W85-04450 2L
W85-04451 5C
W85-04452 5D
W85-04453 5G
W85-04454 5A
W85-04455 5E
W85-04456 5D
W85-04457 5G
W85-04458 5G
W85-04459 5G
W85-04460 5G
W85-04461 5G
W85-04462 5C
W85-04463 5E
W85-04464 5D
W85-04465 5G
W85-04466 5C
W85-04467 5A
W85-04468 5D
W85-04469 5F
W85-04470 8A
W85-04471 8A
W85-04472 2C
W85-04473 5B
W85-04474 5B
W85-04475 5C
W85-04476 5A
W85-04477 5B
W85-04478 5C
W85-04479 5C
W85-04480 5B
W85-04481 5B
W85-04482 2K
W85-04483 2L
W85-04484 5B
W85-04485 5A
W85-04486 5D
W85-04487 5D
W85-04488 7B
W85-04489 5D
W85-04490 5C
W85-04491 5A
W85-04492 5F
W85-04493 5D
W85-04494 5D
W85-04495 5D
W85-04496 5C
W85-04497 5B
W85-04498 5F
W85-04499 5B
W85-04500 5B
W85-04501 5B
W85-04502 5B
W85-04503 5B
W85-04504 5B
W85-04505 5B
W85-04506 5B
W85-04507 5C
W85-04508 5D
W85-04509 5G
W85-04510 5D
W85-04511 5D
W85-04512 5D
W85-04513 7C
W85-04514 5E
W85-04515 5D
W85-04516 8D
W85-04517 8A
W85-04518 8F
W85-04519 6B
W85-04520 5G
W85-04521 5D
W85-04522 5D
W85-04523 5D
W85-04524 5A
W85-04525 5G
W85-04526 5D
W85-04527 5G
W85-04528 2L
W85-04529 2L
W85-04530 5A
W85-04531 5C
W85-04532 5C
W85-04533 5G
W85-04534 2H
W85-04535 5B
W85-04536 2H
W85-04537 5G
W85-04538 2H
W85-04539 5G
W85-04540 5C
W85-04541 5C
W85-04542 2H
W85-04543 2H
W85-04544 2H
W85-04545 2H
W85-04546 2K
W85-04547 2H
W85-04548 2H
W85-04549 5C
W85-04550 2K
W85-04551 5C
W85-04552 2H
W85-04553 2L
W85-04554 2H
W85-04555 2H
W85-04556 2H
W85-04557 5C
W85-04558 2H
W85-04559 5G
W85-04560 5B
W85-04561 2H
W85-04562 5C
W85-04563 2H
W85-04564 2H
W85-04565 5C
W85-04566 2H
W85-04567 2H
W85-04568 2H
W85-04569 2H
W85-04570 2H
W85-04571 2K
W85-04572 6A
W85-04573 6A
W85-04574 4A
W85-04575 6G
W85-04576 5G
W85-04577 2A
W85-04578 2I
W85-04579 2A
W85-04580 4A
W85-04581 5B
W85-04582 5G
W85-04583 4C
W85-04584 5B
W85-04585 2H
W85-04586 7B
W85-04587 6F
W85-04588 6E
W85-04589 7B
W85-04590 5D
W85-04591 5D
W85-04592 5E
W85-04593 5D
W85-04594 5D
W85-04595 5D
W85-04596 5D
W85-04597 5E
W85-04598 6G
W85-04599 4B
W85-04600 5B
W85-04601 5B
W85-04602 5B
W85-04603 2L
W85-04604 5C
W85-04605 5C
W85-04606 2K
W85-04607 5A
W85-04608 2L
W85-04609 5C
W85-04610 4C
W85-04611 5B
W85-04612 2H
W85-04613 2K
W85-04614 2L
W85-04615 5A
W85-04616 5B
W85-04617 2G
W85-04618 3C
W85-04619 5G
W85-04620 6B
W85-04621 5A
W85-04622 5A
W85-04623 2K
W85-04624 5A
W85-04625 3B
W85-04626 5F
W85-04627 8B
W85-04628 6C
W85-04629 8A
W85-04630 8B
W85-04631 8B
W85-04632 5F
W85-04633 5G
W85-04634 2K
W85-04635 5B
W85-04636 5A
W85-04637 5B
W85-04638 2K
W85-04639 2F
W85-04640 2F
W85-04641 5B
W85-04642 5B
W85-04643 4B
W85-04644 5B
W85-04645 2F
W85-04646 2J
W85-04647 5B
W85-04648 5E
W85-04649 5E
W85-04650 5D
W85-04651 7C
W85-04652 5D
W85-04653 5A
W85-04654 5A
W85-04655 7B
W85-04656 5A
W85-04657 2H
W85-04658 5C
W85-04659 5D
W85-04660 5D
W85-04661 2H
W85-04662 2K
W85-04663 5F
W85-04664 5E
W85-04665 2H
W85-04666 2H
W85-04667 2B
W85-04668 2H
W85-04669 2H
W85-04670 2H
W85-04671 5G
W85-04672 2H
W85-04673 2L
W85-04674 5C
W85-04675 2L
W85-04676 2L
W85-04677 2L
W85-04678 2H
W85-04679 2E
W85-04680 5C
W85-04681 5C
W85-04682 5C
W85-04683 5G
W85-04684 2L
W85-04685 6A
W85-04686 6A
W85-04687 6C
W85-04688 3D
W85-04689 8A
W85-04690 3D
W85-04691 3D
W85-04692 3D
W85-04693 8A
W85-04694 3D
W85-04695 3D
W85-04696 5C
W85-04697 2H
W85-04698 2F
W85-04699 5C
W85-04700 2H
W85-04701 2H
W85-04702 2H
W85-04703 2H
W85-04704 2L
W85-04705 5C
W85-04706 5D
W85-04707 8I
W85-04708 5C
W85-04709 5C
W85-04710 5C
W85-04711 5C
W85-04712 2K
W85-04713 8I
W85-04714 2H
W85-04715 5B
W85-04716 5C
W85-04717 5C
W85-04718 5C
W85-04719 2H
W85-04720 5C
W85-04721 5B
W85-04722 2H
W85-04723 2H
W85-04724 2H
W85-04725 5C
W85-04726 2F
W85-04727 2D
W85-04728 2J
W85-04729 2J
W85-04730 5D
W85-04731 5E
W85-04732 2J
W85-04733 2J
W85-04734 2J
W85-04735 2A
W85-04736 2A
W85-04737 2G
W85-04738 2G
W85-04739 6G
W85-04740 2G
W85-04741 5D
W85-04742 7C
W85-04743 7C

W85-04744 3F
W85-04745 8C
W85-04746 2I
W85-04747 4A
W85-04748 4A
W85-04749 4C
W85-04750 5F
W85-04751 5D
W85-04752 3F
W85-04753 6B
W85-04754 6B
W85-04755 6G
W85-04756 6E
W85-04757 5B
W85-04758 2I
W85-04759 2K
W85-04760 2K
W85-04761 2K
W85-04762 2L
W85-04763 2L
W85-04764 5B
W85-04765 5A
W85-04766 6E
W85-04767 5D
W85-04768 8A
W85-04769 5D
W85-04770 5D
W85-04771 5E
W85-04772 5D
W85-04773 5B
W85-04774 5G
W85-04775 5C
W85-04776 5E
W85-04777 5C
W85-04778 6C
W85-04779 6B
W85-04780 6A
W85-04781 8B
W85-04782 8D
W85-04783 8A
W85-04784 6G
W85-04785 6A
W85-04786 4A
W85-04787 5B
W85-04788 5B
W85-04789 5C
W85-04790 2G
W85-04791 2G
W85-04792 5C
W85-04793 2F
W85-04794 2B
W85-04795 2E
W85-04796 2B
W85-04797 5B
W85-04798 6B
W85-04799 5B
W85-04800 5A
W85-04801 2H
W85-04802 2H
W85-04803 5B
W85-04804 2A
W85-04805 7B
W85-04806 6A
W85-04807 2E
W85-04808 5B
W85-04809 5D
W85-04810 5A
W85-04811 4A
W85-04812 2I
W85-04813 8C
W85-04814 2H
W85-04815 2H
W85-04816 5A
W85-04817 2H
W85-04818 2H
W85-04819 8A
W85-04820 5F
W85-04821 5D
W85-04822 5D
W85-04823 2G
W85-04824 2I
W85-04825 2L
W85-04826 6G
W85-04827 2J
W85-04828 5F
W85-04829 5F
W85-04830 5F
W85-04831 5F
W85-04832 5F
W85-04833 5F
W85-04834 5F
W85-04835 2K
W85-04836 2J
W85-04837 5B
W85-04838 5B
W85-04839 2K
W85-04840 8I
W85-04841 2H
W85-04842 2H
W85-04843 2H
W85-04844 2H
W85-04845 5C
W85-04846 2H
W85-04847 8I
W85-04848 2H
W85-04849 2H
W85-04850 2H
W85-04851 5C
W85-04852 5C
W85-04853 2I
W85-04854 2L
W85-04855 2L
W85-04856 2L
W85-04857 5G
W85-04858 2H
W85-04859 6G
W85-04860 5C
W85-04861 5B
W85-04862 5D
W85-04863 5B
W85-04864 5C
W85-04865 5B
W85-04866 5C
W85-04867 5C
W85-04868 5A
W85-04869 5C
W85-04870 5C
W85-04871 5C
W85-04872 5C
W85-04873 5C
W85-04874 5C
W85-04875 5C
W85-04876 5F
W85-04877 5D
W85-04878 5D
W85-04879 5D
W85-04880 5D
W85-04881 5D
W85-04882 2I
W85-04883 2C
W85-04884 5C
W85-04885 5C
W85-04886 5C
W85-04887 2H
W85-04888 5B
W85-04889 5G
W85-04890 5G
W85-04891 5B
W85-04892 5C
W85-04893 5A
W85-04894 5B
W85-04895 5A
W85-04896 2H
W85-04897 2H
W85-04898 5A
W85-04899 2H
W85-04900 2H
W85-04901 2H
W85-04902 5B
W85-04903 5D
W85-04904 2H
W85-04905 5C
W85-04906 2H
W85-04907 2L
W85-04908 2H
W85-04909 2H
W85-04910 2H
W85-04911 2H
W85-04912 2H
W85-04913 5C
W85-04914 8I
W85-04915 6B
W85-04916 6B
W85-04917 6A
W85-04918 6B
W85-04919 3D
W85-04920 3D
W85-04921 6D
W85-04922 3D
W85-04923 6A
W85-04924 6A
W85-04925 6A
W85-04926 8C
W85-04927 6A
W85-04928 7B
W85-04929 5D
W85-04930 7B
W85-04931 5D
W85-04932 5D
W85-04933 5E
W85-04934 2J
W85-04935 8F
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W85-04949 6B
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W85-04951 6B
W85-04952 8G
W85-04953 5D
W85-04954 6A
W85-04955 2L
W85-04956 2G
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W85-04958 8G
W85-04959 5A
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